SCIENCE AND TECHNOLOGY FOR INTEGRATED RURAL DEVELOPMENT

Proceedings of the COSTED Seminar
March 7-8, 1977. Madras, India

Edited by

S. RADHAKRISHNA

Scientific Secretary—COSTED

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Scientific Secretary—COSTED

International Council of Scientific Unions

COSTED

Committee on Science and Technology in Developing Countries

Indian Institute of Science, Bangalore-560 012, India.

Proceedings of the Costed seminar on Science and Technology for Integrated Rural Development.
Edited by Dr. S. Radhakrishna, Scientific Secretary, COSTED.

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KEYNOTE ADDRESS

PROF. S. BHAGAVANTAM
President, COSTED.

COSTED is a scientific committee of the International Council of Scientific Unions and its name is an acronym for the Committee on Science and Technology in Developing Countries. As has been stated in the programme sheet given to all the participants, it so happens that in spite of rapid advances made in science and technology on a global scale, the poor people in most of the developing countries continue to remain poor and to live under conditions of extreme poverty. They are plagued with problems of malnutrition, bad sanitation, lack of basic human needs and appalling conditions of squalor which are an intolerable eye-sore in the midst of any kind of civilised life. While science and scientists the world over, claim to know and to have the solutions for these problems, there does not seem to be much success in the implementation thereof. This seminar has been planned for stock-taking and learning from the lessons of past experience of several participating agencies and frame guidelines for the future. COSTED, because of its limitations of finance and coverage, generally attempts only to bring chosen scientists, research workers, social scientists, management specialists, nutritional experts, teachers and so on, together on one platform and to help them to co-exist for a couple of days in the fond hope that COSTED can play a role as a stimulant or a catalyst to initiate action in the direction of formulating agreed and practical guidelines for tackling the problems of rural development in the best possible manner by the use of science and technology.

If we look at the developing countries, several of them — particularly in the Asian region — have some common features. A substantial proportion of the Gross Domestic Product (GDP) in each case comes from the agricultural sector and a large portion of the people live in rural areas (India, 75 per cent; Sri Lanka 77 per cent; Indonesia, 82 per cent, etc.) The employment pattern

is such that a large proportion of the labour force is employed in agriculture. Thus, one can say with some confidence that the statement: 'Science and Technology for the Developing Countries' will in essence be equivalent to saying ' Science and Technology for the Rural Areas', if we want the benefits thereof to reach the people. It will be equivalent to saying 'Science and Technology for the purpose of increasing the Agricultural Output', if we want the large chunk of GDP to become larger and thus help economic growth and it will be equivalent to saying: 'Science and Technology for the purpose of finding more jobs in Agriculture and Agro-based Industries', if we want unemployment to be relieved in the rural sector. Yet, strangely, past history shows that none of these aspects had received much attention in our countries.

Taking India only as an example, in the first few five-year plans, we gave great prominence to industrialisation and modernisation of industries and in the process, we imported high technology. Our science education laid great emphasis on disciplines like science, technology, chemical engineering, physics, chemistry and so on. Agricultural education was not supported adequately and the interaction of science with agriculture was practically nil. The same applies to animal husbandry and veterinary sciences. We do not seem to have realised that, traditionally, our real wealth had originated from agricultural crops and the cattle and like what we did to all our traditions in other spheres, we allowed this concept of traditional wealth also to wither away and deliberately set our sail on the trail of industrial prosperity. Undoubtedly, to so blindly follow what the affluent countries had done, the temptation came from the glamour of the lifestyle and over-affluence which the industrialised countries had already achieved in addition to the fact of all our educational patterns having been moulded by the western examples. We began industrialising ourselves by borrowing technology at high cost from the western countries and by planting it on a soil where it is exotic, in the hope that it will take root some day. In the process, indigenous skills have either been forgotten or regarded as primitive superstitions. The whole system, being alien and exotic to us, has been pernicious to say the least and it resulted in exactly the same unwholesome

features in the national pattern as it did in the global scene. In the latter case, we know that the rich nations became, and are even now becoming, richer. In the national scene too, the rich people have become richer and the poor people have remained blissfully untouched, unmoved and unattended to. The benefits of science and technology have not reached the rural poor of the developing countries. However, there is now a lot of heart-searching and introspection amongst the planners and scientists. I regard this as a good and welcome change.

Hence this Seminar. While talking about what generally goes under the name of "modern Science and Technology" being exotic to our soil and our being guilty of not having tried to build on an indigeneous base of skills, I would like to quote from what Professor C. V. Raman appears to have once stated:

> "We do not have the wherewithal to make good motor cars in this country. But we have the capacity to build good bullock-carts. Let us give up the former and concentrate our efforts on the latter".

If ungenerously interpreted and quoted out of context, one may see an advocacy to returning to a 'bullock-cart civilisation' in this statement. I do not think that such an interpretation is right nor will it be fair to Professor Raman who was a great son of India. The spirit of it is that no country can afford to overlook the nature of its soil and of the native seeds that alone can sprout in it and instead, plant borrowed technology in its soil and expect it to flourish and grow. Let me repeat what I said a few days earlier

> "Science and Technology too, like democratic government, should in a very large measure be of the people, by the people and for the people".

I would also like to quote a relatively mild indictment of the Indian scientists delivered by no less a person than the (former) Prime Minister of India, Mrs. Indira Gandhi:

"I am concerned that so much of our scientific work is derivative and imitative. There is too much uncritical acceptance of capital-intensive methods. The willingness and ability to explore the possibility of using labour-intensive technologies are conspicuously lacking. The growth of technology in advanced countries leaves us in a perpetual state of having to catch up and the nearer we are to catching up, the farther we get from our people and their worries. We should pay greater attention to smaller problems which affect peoples' day-to-day life, use local materials and power resources, utilise intermediate technology to improve our traditional grind-stone or the wheels of our bullock-cart. There is and there can be no conflict between such technology and modernisation. On the other hand, it will help to make our rural people science-minded and encourage them to participate in the genuine tasks of development".

The substance of it all is that we, the scientific community, for some strange reason which, in my opinion, sprouts from our faulty education, refuse to take cognisance of the traditional skills of our country, recognised all the world over at one time, such as for instance in the area of hand-woven and hand-loom textiles or in the exquisite handwork of the sculptors and the craftsmen and so on. The traditional wind-mill or the farmer's water lift are regarded as not worth looking it. Vitamin C content in the Indian gooseberry or the capsicum or the cashew does not appeal to us, though it was a traditionally accepted and gainfully used important constituent of a balanced Indian diet, as being any good in the presence of equivalent vitamin tablets or capsules made on a large scale by some automated imported modern process, perhaps by using other starting points and a synthetic process.

Development, especially if it is not to be at the expense of some other country or another group of people, is a complex process. This is the reason why, the combined title " Integrated Rural Development" has come into vogue at the present time.

To a developing country like India, development has no meaning if it relates only to the 20 per cent of the elite who in essence and in affluence are no longer Indians in a representative sense. COSTED recognises that a concerted effort in rural development is to-day a major requirement of the developing countries and once again, we are making an effort to bring together a few organisations and individuals interested in this task so that they may compare notes, check their achievements against their expectations, apply the needed correctives and join hands in attaining their common objectives.

I wish the seminar all success and the participants a fruitful time.

SCIENCE AND RURAL DEVELOPMENT*

INTRODUCTION

In many developing countries a large percentage of the population lives in the rural areas and hence the development process of each nation must involve the development of the rural, backward section of the people. Following the pattern of the more advanced countries, the developing countries have placed great faith in science and technology for the solution of their national problems. In a country like India, where more than 70 per cent of the population live in the rural areas, the quality of life of these people has not undergone any percievable improvement during the past 30 years during which the country has had a chance to lay down its own priorities and progress by self-determined objectives. This seminar on Science and Technology for Integrated Rural Development has been planned by the ICSU Committee on Science and Technology in Developing Countries — COSTED, with the objective of examining the science policy that has been followed so far, to highlight success and failure areas, provide guidelines for the future rapid development of the country and examine ways and means of taking the benefits of science and technology to a larger cross-section of people. While the emphasis is on the Indian scene the results will, most likely, be of benefit to all developing countries engaged in the most exciting task of harnessing science and technology for the benefit of mankind. Several distinguished, experienced scientists, economists, management experts and prominent public men have been invited to the Seminar to present their views. This brief introductory note will serve as a background paper.

MISPLACED PRIORITIES

Both on the national and the international scenes considerable amounts of money are being spent on developmental programmes and all agencies are concerned about the lack of develop-

*Introductory paper prepared by Dr. S. Radhakrishna, Scientific Secretary, COSTED, (ICSU Committee on Science and Technology in Developing Countries), Bangalore 560 012, India.

ment, unexpectedly low in comparison to what could be expected from the financial inputs. Science as it is now practiced seems to have no influence on the life style of over 80 per cent of the population. This is obviously because of the fact that priorities, and policies in science are laid down by the 20 per cent of the people who are actually in the field of science and even these people are guided by their counterparts in the more advanced countries. This has led to choices of priorities which are not in keeping with the needs and aspirations of the masses. For instance, in India, there is a flourishing aeronautics industry making supersonic aircraft and some aircraft for agricultural use. There is a well-established electronics industry making TV tubes, sophisticated radars, computers and medical equipment. There is a prestigious Atomic Energy Commission which, among other things, has made India one of the nuclear powers. There is a growing Space Research Organisation which has already brought India into scientific prominence by orbiting an earth satellite.

In other spheres of national development too, India has distinguished itself. It has several institutes of higher learning, a modern telephone industry and several armament factories. But all these technological advances seem to cater to the needs of only the urban population while 60 per cent of the people, who live below the poverty line, keep crying for food, a decent shelter for their living and improved health facilities. Amidst such outstanding achievements of science we see conditions of appalling poverty with millions of people living in conditions which can hardly be called habitable. One frequently asks the question if science, and more particularly, technology, has failed in its objective of social utility.

This situation is not characteristic of India alone. Pakistan talks of indigenously preparing its own atomic fuel in a few years. It too has a sophisticated Atomic Energy Research Establishment. Indonesia has launched, with U.S. collaboration, two communications satellites (Palpa I and II) and has a very large number of scientific institutions. Malaysia has one of the world's best rubber research centres. The Philippines has played

host to innumerable science conferences. And yet in all these countries, while science may have benefited the urban elite, the rural people live in conditions which do little credit to the scientific infrastructure that can be seen, in these countries.

This grave imbalance has been our own doing, for we have laid down priorities in a manner which is alien to our countries. Due to improper local recognition patterns, scientists of the developing countries have been forced to do work which would be recognised by fellow scientists in the industrially advanced societies. Thus, the problems chosen by them, the areas of research work and the educational policies were all fashioned after western or colonial patterns and this created an elitist society which fitted very well into the colonial life style but became alienated from their own surroundings. This accounts for several features like the frustration among scientists, the brain-drain, unemployment and under-employment, seen so often in all developing countries. Addressing the annual meeting of the World Bank, Mr. Robert McNamara recently said, "The annual income of more than one billion people in the world's poorest countries has risen only by about two dollars (to $ 150) in the past decade of massive inflation. But what is beyond the power of any set of statistics to illustrate is the inhuman degradation the vast majority of these individuals are condemned to, because of poverty. Malnutrition saps their energy, stunts their bodies and shortens their lives. Illiteracy darkens their minds and fore-closes their futures. Simple, preventable diseases maim and skill their children. Squalor and ugliness pollute and poison their surroundings. The miraculous gift of life itself, and all its intrinsic potential — so promising and rewarding to us is eroded and reduced for them to a desperate effort to survive. The self-perpetuating plight of the absolute poor simply cuts them off from whatever progress there may be in their own societies. Unless specific efforts are made to bring them into the development process, no feasible degree of traditional welfare, or simple redistribution of already inadequate national income, can fundamentally alter the circumstances that impoverish them". A reordering of priorities is likely to help this pathetic situation and bring about a meaningful quality of life. Science and technology have the answers to the problems

of the poor countries but when they are mixed up with political problems, when the national priorities are topsy turvy, when the goals of scientists are not linked with national needs, science and scientists can play very little role in the development of a country. Even granting political apathy or inaction, a large part of the blame has to be taken by the scientists.

REORDERING OF PRIORITIES

Fortunately in India and in other developing countries there is a large, although still isolated, community of scientists which questions the social relevance of science and research and is demanding a reordering of priorities in such a way that science and its benefits can be taken to the poorest sections of society. What is urgently needed for this is a reorientation of the educational process, which has suffered the most damage, as at present. We seem to be proliferating engineers, scientists, and other professionals. Such people, as a result of their specialised education, tend to migrate into societies where their talent can be put to use and where good monetary rewards are given for their competence. They have not been trained to use their knowledge for the solution of their own countries' problems. Thus the graduates are not employable for meeting local requirements and they end up, at best, in underemployed positions, leading to frustration. In this process of their training they have not learnt to be good technicians but have probably learnt to be good engineers or scientists. Even in important commodity-based areas like agriculture, the agricultural graduates seem to prefer white-collar, advisory-type jobs to using their professional skill for the improvement of productivity.

It must however be realised that the process of undoing an educational pattern with the intention of building a better one is at least as difficult as building up a system. In this interim period what strategy should the developing countries adopt? Obviously this is going to be a difficult task, for the scientists who have already undergone training are specialists in their own areas of interest and they will literally have to 'forget' their areas of specialisation in the national interest. In fact this specialisation and aliena-

tion from national needs and priorities are so deep-rooted that scientists often ask: "What is wrong? We are doing our job of building up the scientific infrastructure". A time has come when all national programmes and all national priorities must be directed towards the poorest sections of society.

In all fairness it must be acknowledged that the politicians have been urging scientists to get away from their ivory towers and direct their talent towards the amelioration of the problems of the poor. Speaking of India's nuclear programmes, a senior Indian politician said, "While there is a single hungry child in India, while there is a shelterless family, while men line up in queues to get an opportunity of earning a miserable pittance, while ignorance and superstition undermine a nation, how can any sane person talk in terms of prestige of competition in the art of destruction". One of India's Prime Ministers said, "It is science alone that can solve the problem of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people. Who indeed can afford to ignore science today? At every turn we have to seek its aid. The future belongs to science and those who make friends with science". A senior science policy maker recently said, "With the large infrastructure built up for science and technology and with all the imports of technology, the nation nurtured the expectations that a spontaneous interaction of science with society would follow resulting in speedy growth and development. But has science and technology in India lived up to the nation's expectations? What has gone wrong? It could be that science, technology and development have not been properly integrated or there exist gaps in the understanding of the social, economic and political implications of science and technology, or there is little interaction of science with society. This then calls for a policy, planning and strategy for science to serve society". Presenting a document on "Strategy for Integrated Rural Development" a former Indian Finance Minister said, "The challenge facing us is for harnessing the potential of science and technology for the optimum use of all natural assets — human, animal and physical — for banishing poverty from our midst".

These exhortations have been falling on deaf ears and it is only in recent times that one can observe a certain amount of heart-searching, at least for the sake of external appearances, among the scientists. Recently (in 1976) the annual Science Congress of India (consisting of over 4,000 members) had a focal theme entitled " Science and Integrated Rural Development — An Agenda for Action". The Malaysian Scientific Association and the Malaysian Institute of Chemistry have organised a seminar on "Quality of Life — The Role of Chemistry". The Pacific Science Association is to organise, in Indonesia, an International Conference on Appropriate Technology. The World Bank has been promoting projects aimed at benefiting the poorest of the poor. The United Nations has been directing its resources towards the 25 'hard-core' least-developed countries and several other international agencies are reorienting their programmes. Although the benefits of all these concerted efforts are yet to be seen, one hopes that these will succeed and some relief is brought to the suffering millions.

THE MAGNITUDE OF THE PROBLEM

The magnitude of the problem is staggering. What is worse, the worst-hit are the children. Although we often hear platform speeches declaring "The child is the citizen of tomorrow", children seem to be the most neglected, in the developing world. As an example it must be stated that a recent World Health Organization (WHO) survey shows that over 100,000 children go blind every year because of improper and inadequate food intake. A pathetic tale indeed! These young people are surviving for leading a life which has little to hold out for them. It is well known that acute diarrhoea is among the three leading causes of death in Asia's developing countries, and that it kills thousands of children every year. It is the most common cause of death among children under three years of age. This cause of death is most prevalent in the Philippines. All these are urgent problems for the developing world.

A World Bank sector policy paper on Rural Development states that approximately 85 per cent of the 750 million poor

in the developing world are considered to be in absolute poverty. If a definition is necessary, the World Bank classifies those with an annual income of less than $ 50 as being absolutely poor. The remaining 15 per cent are judged to be in relative poverty having incomes about the equivalent of $ 50 but below one-third of the national average per capita Gross National Product (GNP). Thus it is obvious that even if we attempt an overall increase in GNP it need not effectively increase the standard of living of the really poor people. Of the population in developing countries considered to be in absolute or relative poverty, more than 80 per cent are estimated to live in rural areas and rural development can therefore be described as a strategy to improve the economic and social life of this specific group of people. The World Bank survey papers also showed that about 550 million people suffer from absolute poverty and of these more than 350 million live in the four Asian countries: India, Indonesia, Pakistan and Bangladesh. In these Asian countries, which have a combination of extensive rural poverty and low levels of mobilizable resources, the problem becomes nearly intractable and calls for a determined single-minded approach if even a glimmer of hope has to be seen.

ROLE OF SCIENCE AND TECHNOLOGY IN THE BATTLE AGAINST POVERTY

Undoubtedly, modern science and technology provide us with the means to defeat the problem of poverty, but as long as national priorities are dictated by considerations other than national needs, as long as educational and recognition patterns are not in keeping with national goals and as long as the goals of scientists are not linked with national needs, we will be fighting a losing battle. After all, science can claim many victories over dreaded problems. It has helped in the fight against malaria, it has helped in the battle against diarrohea, it has helped in increased productivity, it has provided many solutions to many social problems. There is no doubt that if the developing countries did not resort to the use of science and technology for the solution of their national problems, their plight would have been much worse. What is urgently required is that proper direction must be given

to science policy. The picture of colossal poverty, disease and squalor can be changed by following a process of integrated rural development, with carefully planned adoption of scientific principles and channelling of substantial amounts of financial resources for mass benefits. The biggest role which science in general and medicine in particular can play in this battle against poverty is the improvement of health-care facilities for the rural people. This undoubtedly is the foremost of today's problems and is certainly within reach of present-day technological levels. What is required is a political commitment, a band of dedicated scientists and, above all, a national populace which will appreciate such efforts—for the greatest satisfaction which a scientist can hope for is public acclaim. What is required is not new science or new technology but application of science for the solution of urgent problems. A senior Indian Cabinet Minister speaking at one of the recent COSTED seminars said "For hundreds of millions of poor farmers, life is neither satisfying nor decent. Hunger and malnutrition haunt their families. Illiteracy forecloses their fortunes. Disease and death visit their villages too often, stay too long and return too soon. What these men want is a source of employment for their survival, shelter for their families and a future for their children. They want the simple satisfaction of working toward some better future, toward an end of misery and a beginning of hope. We are talking about hundreds of millions of desperately poor people; we are talking about 80 per cent of our entire population who live in the villages, not counting the urban poor. Development is simply not reaching them to any decisive degree. The country may be growing in terms of GNP, in terms of industrial and agricultural production, in terms of export achievements, but their individual lives are stagnating in human despair. I think it is within the power and ingenuity of scientists to increase their contribution towards ameliorating this situation, by making scientific activities more relevant and more appropriate to the needs of our poor".

The problem in India and other developing countries is that the benefits of the planning and development process have not trickled down to those for whom they are most essential. This should not mean, as is often made out, that we should give up

our industrial base and swing back to agriculture. What it means is using industry more for the sake of agriculture. An Indian newspaper in an editorial recently, stated "Scientists are not aware of what is happening elsewhere outside the precincts of research institutes and laboratories. The basic needs of a village are: drinking water and sanitation. According to the statistics available, only seven per cent of villages in India have 'potable' water. Sewage covers still fewer places. These facilities apart, a great majority of the people in villages live in *kaccha* (unfinished) houses. The houses have no sanitary facilities of any kind.

"Scientists have done very little to lessen the drudgery of living in villages. In fact, they have spent millions of rupees on such research projects as have no relevance to actual conditions. Impressive buildings and up-to-date equipment are there but what comes out of them does not in any way add to the comfort of the people. Research is conducted for the sake of research. High-sounding theories are aired, more to win recognition in the academic field than to seek solutions to the piling problems of backwardness, squalor and malnutrition. Increasingly, science is getting away from the people. It is concentrating on methods to destroy humanity, not to give it comfort or succour".

FUTURE—BRIGHT OR BLEAK?

Whether the future turns out to be bright or bleak will be determined by the concerted action the developing countries take against poverty, malnutrition and ill health. What is called for, is action rather than theories, proposals, commissions and the like. Speaking at the Annual Indian Science Congress session in 1976, a senior member of the Planning Commission said, "I have heard, in the course of this Science Congress, that we possess one of the largest aggregates of scientific talent in our country as compared to the rest of the world. However, one has to consider, how is it that this community — so large, so numerous in our country, fails to make an impact on the general evolution of society and of our country. Why is it so insignificant in making its voice heard in respect of problems of social, political, economic and even of scientific transformation. I have often said that the

scientific community of India itself, lacks a focus. It has no focus; it has no platform; it has no organisation. You can pass a hundred resolutions; you can have a hundred congresses, but you will cease to make any impact, because you lack the focal point yourself. Why not make this year, a year not merely of elaborating integrated rural development in a generalised way, but adopt one district where the universities and the scientific establishments in India can demonstrate concretely what we can do in one year to transform one of the more backward areas of our country. One of the advantages of this would be that we shall cease to theorise; we shall have to address ourselves not to the generalities of the 363 districts of India, but to the concrete problems of one district of India in an obviously backward state". This is a fairly strong indictment of the scientists and should have had a tremendous impact on the scientists. However one must be cautious that mediocre scientists, sensing the mood of the day, will not jump into the bandwagon for the sake of cornering research budgets while producing no meaningful results. Fortunately, "Development" is a more quantifiable term than "Search for Truth". In the past, many scientists have taken to a path where they neither do good basic science, nor do they do work of use to the country. Unfortunately the plea to do work which will promote social development is misconstrued and interpreted as advocating mediocrity. Basic science must be pursued, but not at the cost of incurring social indictment and not by people who have no aptitude for basic science. Many young scientists, stepping into the threshold of a career in science, complain of lack of proper guidelines, objectives and leadership and quote this as a cause of the present lack of relevance.

An important point for the future is that for rural development no new 'high' science is required. The science that is available is competent to tackle the problems. What is required is, application to specific target areas. To give a few examples: a proposal to investigate new sources of Vitamin A to cure child blindness is less important than a programme aimed at social upliftment of a large section of the population by using the available techniques. Spreading development is far more important, if science has to gain the confidence of the people and regain

credibility. A project aimed at improving water facilities for a particular community is far more important than research into new methods of water purification. This statement should not be picked out of context and interpreted as a discouragement for new innovations. We are talking here of urgent, relevant, priority action areas.

In this process of nation-building there is no alternative for the developing countries except to follow a selfdetermined path. The lessons of foreign aid have been disastrous. Recently, in 1975 a group of eminent social scientists from developing countries gathered together in Karachi, Pakistan, and formed the Third World Forum with the objective of promoting intellectual self-reliance. In an opening speech a distinguished economist from Pakistan said, "History has taught us at least one lesson: that the poor and the weak always get exploited unless they get organised. Our present world order is no exception. We have often seen our poverty and our weakness exploited in the name of grandsounding principles.

"When we protested against deteriorating terms of trade for our countries, we were quietly informed that this was merely the working of a free international market mechanism, and we were left to puzzle for ourselves why, by some curious coincidence, the market mechanism always worked to the detriment of the poor nations.

"When we embarked on our economic development, we were taught to worship the goddess of GNP growth and to chase certain per capita income targets, and when we raised questions, we were politely told that this was the essence of western experience. We were left to discover for ourselves through our own sad experience that the character of growth and distribution of its benefits was as important as growth itself and that there could be no meaningful development for the bulk of our populations unless there was a direct attack on mass poverty and satisfaction of minimum human needs through our indigenous efforts and through our own value systems.

"At the beginning of a programme of international assistance, we were assured that there would be a true partnership in development and genuine transfer of real resources. We found out only later that there can be no true partnership between unequals and that the promised transfer of resources was both too inadequate and too burdensome.

"It is rather an unpleasant truth that poor countries in the Third World have often been swindled out of a decent return for their produce in the name of market mechanisms, deprived of their economic independence in the name of world interdependence, seduced by imported life styles, foreign value systems, irrelevant research designs — all in the name of freedom of choice. And we have also seen the same grand-sounding principles change with an amazing suddenness when the shoe was on the other foot. When the OPEC nations demanded a higher price for their oil exports, it was dubbed as 'exploitation' and 'blackmail' rather than the workings of the international market mechanism where the price of a commodity is supposed to be determined by the opportunity cost of its substitutes.

"No exploitation can continue for long except with the tacit cooperation of the exploited. I am afraid that we have allowed a minority in the developed world to shape world opinion for too long a time. If there is any fault, the fault is clearly ours.

"This is where we have failed. This is where a realistic beginning must be made".

It is now well-known that while poverty brings problems: malnourishment, ill health and squalor, affluence brings along with it social problems like drug-addiction, high suicide rates, high crime rates, etc. It is important for developing countries to learn this important lesson while aspiring for technological benefits. Growth with limited needs, and satisfaction is very vital and thus while looking up at the horizon of development the developing countries should not lose sight of their traditions. While climbing up the ladder of technological affluence they should take care, that while they approach the top, they do not

fall to the depths of barbarity where all human values are eroded. Among developing countries themselves, there are small countries where even the scientific infrastructure is not available presently. They should note that what is important is the creation of the *right kind of scientific manpower and infrastructure* and not just large numbers who cannot participate effectively in the most important process of nation-building.

RURAL DEVELOPMENT PROGRAMMES AND PLANS

The most important task for any developing country is to aim at eradication of mass poverty by spreading the benefits of science and technology. In this great adventure, many developing countries, like India, are facing several practical problems.

In recent years there has been a tendency amongst intellectuals and professionals to adopt a rural area and to 'talk' about rural development merely because others are doing so. It is precisely at such times that a candid examination of tasks and priorities is called for. Every developing country has to be cautious about programmes being categorised as 'applied science', 'appropriate technology', 'goal-oriented research', etc., because the nurturing of basic science, leading to excellent and exciting discoveries is as important as 'need-based' or 'grass-roots' science. It is very essential for the developing countries to strike a balance between these two. What should be noted is that scientists should not do mediocre aimless research while purporting to do basic research nor should they, while doing goal-oriented research, forget the basic objectives of scientific work.

The process of linking up the existing scientific infrastructure of prestigious research laboratories, tradition-bound universities and professional institutions with the social structure of the country is a difficult task. In India, many laboratories belonging to the council of Scientific and Industrial Research (CSIR), several university colleges, technological institutions and social organisations have embarked on rural development programmes and in this section the results of such programmes are described by those who are actively leading and co-ordinating them. Several of the projects are in the initial stages but there is a firm belief that the initial lessons are very valuable for laying down priorities for the future.

SCIENCE AND TECHNOLOGY FOR RURAL DEVELOPMENT

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Eighty per cent of India's population lives in about 600,000 villages. Almost 50 per cent of these people suffer from poverty, inadequate medical care, poor education facilities, lack of improved agricultural practices, no proper communication methods, non-availability of cheap and better sources of energy and clean water supply. In spite of our concerted efforts to improve the conditions of this unprivileged class of people, we have not been able to make them benefit in a substantial manner with the advancements in science and technology. It is the objective of this paper to highlight the areas where the application of science and technology can improve the village economy and bring about general improvement in the socio-economic status of rural India, and which have been included in the National Integrated Rural Development Project. The role of the Department of Science and Technology of the Government of India has also been briefly outlined.

After independence, considerable efforts were made by the Government of India to improve and modernize Indian agriculture and provide better facilities to the farmers to increase the productivity and raise their standard of living. Special mention could be made of the programmes such as projects for drought-prone areas, hill area development, integrated tribal development, small farmer's development agency, marginal farmers' programme, extension service and several operational programmes of the Indian Council of Agricultural Research and the Ministry of Agriculture and Irrigation. As planning progressed, a careful assessment of the ongoing programmes was made periodically and it revealed that many of these programmes have not made any dent in improving the socio-economic conditions of the rural

poor. Therefore a more effective strategy had to be planned. In view of this need, a separate Department of Rural Development was established in 1974. With the establishment of this Department, systematic and careful planning of rural development projects was given a new impetus. Although it was realised long ago that science can alleviate the sufferings and minimize the drudgery of the rural poor, yet an integrated approach for transfering modern scientific and technological innovations to rural India, has been given a major thrust only recently, after the (former) Prime Minister Mrs. Indira Gandhi's call while addressing the 63rd session of the Indian Science Congress, to scientists, technologists, administrators and planners. She said, "Science, with its spectacular achievements in increasing production and multiplying a thousand-fold the speed of man's movement and the range of his sight and sound, has aroused limitless expectations. And what is more, it has the capacity to fulfil them. The challenge before leaders of science and moulders of national and international policies is to direct the known and proven capacities of science towards the removal of hunger, want and the diseases of privation." The Union Finance Minister, while presenting the budget, presented a paper on strategies for integrated rural development outlining the strategies and policies to be adopted for taking up this challenging task. As a follow-up, a working group has been constituted and considerable work has been done in identifying the districts, drawing up the plan of action and preparation of a 'Resource Inventory' for 20 districts. The districts are : Mahboobnagar (Andhra Pradesh), Kamrup (Assam), Rohtas (Bihar), Kutch (Gujarat), Hissar (Haryana), Kangra (Himachal Pradesh), Anant Nag (Jammu and Kashmir), Cannanore (Kerala), Tumkur (Karnataka), Bastar (Madhya Pradesh), Chandrapur (Maharashtra), Garo Hills (Meghalaya), Puri (Orissa), Hoshiarpur (Punjab), Banswara (Rajasthan), Dharmapuri (Tamil Nadu), Mirzapur (Uttar Pradesh), Tehri Garhwal (Uttar Pradesh), Bankura (W. Bengal) and Wardha (Maharashtra).

This has been a collaborative effort of the ICAR (Indian Council of Agricultural Research), CSIR (Council of Scientific and Industrial Research), Department of Rural Development, Department of Science and Technology, ICMR (Indian Council

of Medical Research), Department of Space, Department of Meteorology and many other governmental and non-governmental agencies. The introduction of the focal theme "Science and Integrated Rural Development" in the Indian Science Congress also gave a new forum to biologists, mathematicians, chemists, physicists, home science experts and educationists to think on these lines and at the end of the session a set of recommendations were drawn up for implementation of this unprecedented task. As a result, a number of universities, IITs (Indian Institutes of Technology), Polytechnics and other research institutions have been mobilized to initiate R and D efforts for rural development and take up extension projects in rural areas. Dr. M. S. Swaminathan, Director General, ICAR and Secretary, DARE (Department of Agricultural Research and Education) had mentioned, in his presidential address to the congress, that we have in India the 3rd largest stock of scientists in the world, yet they have not been utilized optimally to solve the problem of the villages in particular, and until and unless the technology is given a rural bias, the poor man will not benefit from the modern innovations.

Village development is a highly complex endeavour and an integrated approach involving various disciplines of science and technology is needed to effectively implement the projects in rural areas for the benefit of the common man. The concept of an integrated approach has been mooted with the objective of looking for a uniform, harmonious growth in various areas of agriculture, waste utilization, agro-industries, rural housing, health, family planning etc. Such an approach would bring about general awareness in the village community and would also bring about the involvement of the local populace in the developmental programme.

Let us examine the strategy of rural development from the point of basic minimum needs. These are food, clothing and shelter. Food production can be increased by the introduction of high-yielding, disease-resistant varieties, good quality seeds, use of pesticides for eradication of pests and diseases, and adoption of modern agricultural practices.

Irrigation is vital for agricultural production. Research should be directed towards the optimum utilization of ground and surface water resources and rain water collection in irrigation. Up to the 4th five-year plan period, irrigation potential has increased and the percentage of utilization of water has gone up from 10 per cent to 35 per cent. The 5th Plan (1974–79) envisages an additional utilisation by the creation of more irrigation potential of 12.2 million hectares.

Next comes post-harvest technology. Better methods of threshing, drying, cleaning and storage can be employed for the preservation of the quantity and quality of foodgrains, for example, use of better storage structures like plywood silos, Puasa bins, cement structures, and use of fumigants and methods of grain protection from rodents and fungi etc.

A good multi-purpose *chakki* (grindstone), which can grind the grain and pulses, should be made available in the vicinity of every 5–10 houses. In the hilly areas of the country, the womenfolk carry 20–25 kg of foodgrains to about 10–15 km on hilly track for grinding. There is now available a very simple technology, for improving the existing *chakkis*, which has been tried out in some villages and can be popularised further.

In the country, 17 Agro-Industries Corporations have been established and several *Krishi Vigyan Kendras* have been created. These impart training to villagers and make available modern agricultural implements, fertilisers and good quality seeds to them. At present we would like to further extend the activities of these Agro-Industries Corporations by giving them some developmental projects for implementation, such as recycling of wastes, animal husbandry and fisheries programmes, etc.

The problem of rural housing has to be tackled on a war footing. More than 70 per cent of the houses in the country are still made of mud and they may leak and are generally fire-prone and unhygienic. The National Buildings Organisation (NBO), the Central Building Research Institute (CBRI) Roorkee and many other organisations in the country have taken up the task of improving the quality of rural building materials by simple

application of coal-tar ingredients, cement, the use of thatch roof materials and of agricultural and plywood wastes or veneers. Many of the houses which are made of thatched material or grass are fire-prone. Therefore, R and D efforts are being directed towards this area of fire protection.

It is understandable that a common farmer's investment capacity is limited to a few thousand rupees only. Use of cheaper materials like clay tiles, bricks, bamboo, palm leaves, mud plaster etc., have therefore, to be optimized. This calls for the setting up of demonstration houses in a cluster of villages. The NBO with its 5 rural wings is already doing this work. Several research institutions have also taken up R and D work in the area of roofing material, timber seasoning and preservation techniques. The CBRI, Roorkee, has done work on large-sized clay products with improved strength, water-proofing of mud walls and fire-retardant treatment for thatch. This know-how has been passed on to factories for making demonstration houses. The demonstration houses should lay emphasis on hygienic conditions in the villages, durability of construction material, proper layout, etc.

There is an urgent need to properly use the available energy resources. This energy can be used to run the pumpsets for irrigation and drinking water supply, lighting the village or cooking purposes. Biogas plants which use dung, agricultural wastes and night-soil have already been installed in a number of villages. At present there are about 30,000 biogas plants operating in the country. But proper management and regular engineering consultancy services for their efficient functioning should be maintained. A small family-size unit would cost Rs. 2,000–3,000 with a minimum of three cows. But in order to popularize the biogas plant, community gas plants should be encouraged. Considerable R and D efforts have been put in now to maximise the use of unconventional energy sources. Intensive research work has been undertaken on solar heaters, dryers and cookers. The research projects are oriented to meet the needs of rural people. Once the techniques have been standardised, they can be transferred to rural areas.

Sanitation and disposal of wastes is still a very serious problem in the villages. Construction of soak pits, sewage reclamation by growing algae, construction of a covered drainage system, etc., are some of the important developmental projects.

Tree plantation is one of the most important programmes which has to be introduced in the rural areas. Proper identification and cultivation of plants of economic value like fruit trees, coconut trees, palm trees, medicinal plants and edible mushrooms are some of the important examples. Species of *Acacia* can be grown, the trunk is used as fuel and leaves as fodder and green manure. Plants can also be cultivated for use in industry, *e.g.*, grasses, *Eulaliopsis binata* (*Sabai grass*) can be used as a raw material for paper, thread and rope making. Oil palm is used in the soap industry and the oil also contains vitamins A and D used for pharmaceutical purposes. Use of indigenous herbs for medicinal purposes has to be popularised in villages.

RURAL INDUSTRIES

To increase the income level of villagers, it is absolutely essential to start small-scale industries which utilize locally available raw-materials. This would generate more training facilities as well as employment potential for the local people. The Rural Artisans' programme was started as part of the Small Farmers' Development Agency (SFDA) scheme, in 81 selected areas in 1971–72. Later, in 1973, the Rural Artisan programme was merged with the Rural Industries Project. A budget provision of Rs. 3.8 millions has been provided by the Planning Commission for 1976–77. The main objective of this programme is to train the village artisans and agricultural labourers, both male and female, in various sectors. Important trades like carpentry, blacksmithy, pottery, masonry, tractors, pumpsets, diesel engines, etc., where modern technologies can help to a large extent to improve their efficiency, have commenced. The Rural Industries Project programme has been started in 41 districts. These are mostly the backward districts and the introduction of appropriate technology would enable the villagers to maximise their production, based on local skills and resources. It is proposed that,

ultimately, this entire programme would be extended in the identified 20 districts, listed earlier, with a view to transfer the technology for improving the cottage industries in these backward areas.

Improvement in some of the existing technologies can benefit the farmer to a great extent. To increase the supply of oil for local consumption, the villages are still using the bullock-driven *ghani.* It is essential to use a power-driven *ghani* which can replace the ordinary one. A refining unit is also necessary for ensuring better quality oil for the villagers.

The Indian Khadi and Village Industries Commission (KVIC) has done a good deal of work on one of the fine soft-drinks, *viz., Neera* which can be obtained from the palm tree. Careful and systematic planting of palm trees and adoption of proper pruning methods will ensure a good supply of drink for the villagers. The product is good from the nutritional point of view. Proper processing and preservation of this valuable soft-drink would generate more employment potential for village artisans and would provide a good and cheap source of soft-drinks to them. Jaggery can also be prepared from *Neera.* This industry can immediately be started in palm-growing areas. Palm trees can be used for preparation of rope, baskets, thread, many edible products and some pharmaceutical items. The Directorate of Publicity of the KVIC has done a commendable job in this area of village industries, with its network of organisations all over the country, but the modernisation and reorientation of some of these pilot projects is essential. Lime, which is very well known as rural building material for ages, has been used in our villages also. The lime manufacturing industry in India is fairly old, but recently, with the advent of modern technological innovations, the existing designs of kilns have been improved, resulting in more efficiency and a saving in the cost of fuel consumption, to a great extent. This industry can be developed considerably as we have very huge lime-stone reserves. The waste lime-stone can also be used for reclamation of acidic soils.

Pottery-making is yet another very common industry in villages. Recently a number of improved scientific methods

have been introduced by the KVIC to modernize the traditional methods. A new design of the wheel, pottery-making using ball bearings and various kinds of wheels *viz.*, rope-driven and belt-driven, have been developed. A number of schemes for the improvement of the existing designs of various implements like the *charkha* (hand-operated spinning wheel), simples pinning machines, etc., have been introduced by the KVIC in the last 20 years.

RECYCLING OF WASTES

Recycling of wastes, especially agricultural, animal and forestry wastes, has been given a major thrust for the improvement of the village economy. R and D work on projects like rice bran and rice husk utilization, coconut and arecanut wastes, mango kernels, fruit and vegetable industry residues etc., has been going on for quite some time in many ICAR and CSIR laboratories. An attempt is now being made to assess the techno-economic feasibility of such projects, for rural areas.

Cultivation of algae in tanks constructed by farmers on their farms has also been given special emphasis. Algae can be used as biofertilizer in rice fields, as animal feed and, to some extent after careful nutritional and toxicological tests, as proteinaceous human food.

Modernisation and improvement in the existing design of bullock carts can prove to be beneficial. These aspects are also being looked into by various research organisations and prototypes are being made.

HEALTH AND FAMILY WELFARE

Special emphasis has been given in the integrated rural development project to health care programmes such as: removal of nutritional deficiencies of iron and folic acid, adoption of fertility control methods, special care during the child-bearing stage and immunisation against communicable diseases like diptheria, cholera, worm infections, etc.

At present there is one doctor for every 10-15 thousand population in the rural areas. The medical facilities are far too inadequate and even the existing primary health centres are not fully utilized due to sheer ignorance. Strengthening of the primary health care centres, adequate provision of necessary medicines and training of the villagers in the use of these medical facilities, has been stressed. Establishment of a referral service system for serious diseases is absolutely essential to avoid untimely death of the poor people. Emphasis has also to be given to *Ayurvedic* (Indian System of Medicine) Dispensaries and popularisation of indigenous systems of medicine. Very simple procedures like fortification of common salt with iron, making protein-rich flour for the applied nutritional programme, correcting the common vitamin A and C deficiencies by supplementing the diet, preventive measures for different diseases, and provision of clean drinking water supply, which will prevent the spread of many deadly diseases, are some effective measures which will have to be adopted immediately to ensure a healthy and happy living for rural people.

Transfer of appropriate technology to Indian villages, which is a major challenge, can to a large extent solve the problem of the economy of the village. The know-how developed in the laboratories is passed on to a limited section of the society. This has resulted in the emergence of two types of society, one which utilizes the technological innovations and the other which is still not aware of these innovations and continues to practise age-old methods of agricultural and non-agricultural operations. This gap has widened during the years. During the 1st Plan, the rural employment was estimated to cover 2.8 million people. This was recorded on the basis of the first agricultural labour enquiry in 1950–51. By the end of the 2nd Plan (1956–61), it was envisaged that 3.5 million jobs would be created in the agricultural sector and 10.5 million in the non-agricultural sector. In the draft 4th and 5th Plans, estimates showed that there was a backlog in the employment of 7 million people in rural areas. This backlog has been increasing continously and for creating more jobs, greater emphasis has to be given to the establishment of rural industries. Therefore, the industries will play a crucial role in improving the village economy. A very important step

in this direction is a systematic, carefully planned survey of our available natural resources like minerals, forests, flora, fauna, water, etc. The focal theme of this year's Science Congress was "Survey, conservation and utilization of resources". It was suggested, in the recommendations of the Science Congress, that micro-level studies on the resources and their utilisation be initiated. As a matter of fact, after Dr. M. S. Swaminathan introduced the concept of 'Science and Integrated Rural Development' as the focal theme of the Indian Science Congress last year, the trend of the Science Congress has changed and it is no more an academic exercise in the presentation of research papers. Action-oriented recommendations have been made and a steady follow-up is being maintained. Although science and technology have a very crucial role to play in the development and improvement of our villages, yet a collaborative approach amongst the different sections of society is required to successfully launch this campaign of transfer of technology to rural India. We will have to develop an operative mechanism to fully utilize our manpower, trained skills, scientists, engineers and doctors for extensive application of science and technology to achieve success in this herculean task of rural reconstruction. Hard and sincere work, an integrated approach, active and meaningful cooperation of our men, reorientation of our strategies, and formulation of suitable guidelines would help to remove poverty from India and transfer the benefits of our scientific and technological innovations to the weaker sections of the society.

Agricultural production, if it can be raised, can give more employment facilities to the rural people. It has been estimated that even if half of the irrigated area, which is 28 per cent of the total, can be used for double-cropping by modernisation of agricultural techniques, an additional quantity of 15 million tonnes of food-grains can be obtained. Similarly, our forests which occupy almost 22 per cent of the land area can contribute significantly to rural development by establishment of paper, pulp, plywood and other industries. Only 25 per cent of the villages have electricity but it is presumed that in the next three years about 8,000 additional villages can be electrified and 13,000 pumps can be set up.

Some of the areas for which funds have been earmarked by the Government are: land reforms, minor irrigation projects, animal husbandry, soil conservation, fisheries development, small-scale industries, the handloom, powerloom and coir industries, sericulture, etc. The Department of Science and Technology, through its related organisations like the Botanical Survey of India, the Zoological Survey of India, the National Remote Sensing Agency and the Indian Photo-interpretation Institute, has made a substantial contribution in furnishing information regarding the flora, fauna, topography, forest and land-use patterns, water resources, etc., in the 20 selected districts. The Botanical Survey of India has given details about the vegetation of these particular areas, describing the fodder plants, crop plants, non-edible oil seeds, fibre-yielding plants, medicinal plants and other species which give gum, resins and tannin. This information is very useful and, based on the flora of a particular district, suitable industries can be developed and the need for cultivation of more trees can also be visualised. Similarly, the Zoological Survey of India has provided the requisite information on the fauna of these 20 districts giving in detail the description of mammals, birds, reptiles, amphibians, crustaceans, hymenoptra etc. This information is valuable for starting some animal husbandry programmes and for starting industries based on their by-products and wastes. The knowledge about the fauna of a district can be used in various ways, *e.g.,* in civet farming, musk farming, *chittal* farming, skin curing and tanning centres, poultry development, venum collection centres, fish development, use of butterflies for preparation of decorative plates etc. The secretion of the scent gland of civets can be used for preparing perfumes and pharmaceutical products. All these could be given by the Zoological Survey of India to the implementing agency.

The Indian Photo-interpretation Institute (IPI) has made available the basic statistical information obtained from the pre-investment survey of forest resources, the field surveys carried out by the IPI, the harvesting activity, primary manufacturing industries, etc. The Survey of India has given maps of various regions. The actual mineral deposits in various regions have also been clearly indicated. Occurrence of lime copper, lead resource reserves, etc., is also given.

Science and technology can play a very important role in improving the living conditions of rural women and children. Some of the elementary needs of the rural women are the improvement of the *chulhas* (domestic coal stoves) which are highly inefficient and hazardous to health. As a result of constant exposure to smoke, the women suffer from eye diseases, respiratory diseases and develop increased susceptibility to other ailments. Popularization of *gobar-gas* (dung-gas) plants with improved burners can bring great relief to these women. Similarly, provision of clean drinking water supply would save them from enormous labour and also prevent many communicable diseases. The time wasted for this can be utilized in some other productive work.

In rural areas, it is not uncommon to see a woman with four or five children by the time she is thirty. Thus, as a result of repeated pregnancies, women age fast and suffer other consequences to their health. One of the most common drudgeries of rural women is pre-natal and post-natal care. A majority of the city children receive triple vaccine injections which provide protection against whooping cough, tetanus and polio. Ignorance and superstition prevent rural people from immunisation against these deadly diseases. This results in high morbidity and mortality rates. Similarly, certain vitamin deficiencies which can be very dangerous can be avoided by timely availability of medical advice, medicine and nutritionally balanced food. Identification of the felt needs of the people; scientific, social and educational organisations which can implement the projects; a methodology to get feed-back information and disseminate it in villages, adopting a total system approach for agricultural and non-agricultural and scientific operations; establishment of industries based on locally available raw materials; indigenous technology, to employ local people and compulsory training to men, women and children, these constitute the essential elements of the integrated approach which has been adopted now for rural development programmes all over the country.

In conclusion, I would like to quote a few words of the founder of nation, Mahatma Gandhi — "India is to be found not in a few cities but in the villages. Farmers and workers make

India. Their prosperity alone can make India a country fit to live in". And later, Pandit Jawaharlal Nehru said, "It is science alone that can solve the problem of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people".

GANDHIGRAM

AN EXPERIENCE IN RURAL DEVELOPMENT

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Gandhigram is a humble attempt at developing a model for reconstructing villages in India on the tenets enunciated by Mahatma Gandhi and on the precepts shown by him in this direction throughout his life. This bold attempt for such a mighty task was initiated under the leadership of Dr. (Mrs.) Soundram Ramachandran with a small band of committed workers. It began as the Tamilnadu Branch of "Kasturba Gandhi National Memorial Trust" of which Dr. Soundram Ramachandran was the leader chosen by Mahatma Gandhi himself. Gandhigram was inaugurated on October 7, 1947 to train village women for "*Samagra Grama Seva*" (Integrated Rural Development) with special emphasis on women and child welfare. Numerous women workers have been trained since then for this work and are functioning in many remote and backward villages of Tamilnadu.

The need for health care of women and children became apparent as the work began. There had to come a small hospital with a doctor visiting village centres in the afternoons and attending to the patients coming to the hospital in Gandhigram in the mornings. The patients were treated and cured at the hospital, and the preventive part of it was done carefully through a systematic but informal programme of health education in antenatal care, infant nutrition and family welfare. Medical work was thus the medium of contact between Gandhigram and the villages around. We had to have this contact as we had set our objective, amongst others, "to build up a casteless and classless society of complete justice to the common man through wholly non-violent effort and with special emphasis upon the social and moral values of manual labour".

In order to move on towards this objective, we had to organise programmes of education for the young and the old. Realising the inadequacy of the existing system of education, its failure to recognise reality and include it in its content and its unwillingness to provide an opportunity for the development of the personality of the child, Mahatma Gandhi evolved a philosophy and system of education through which there could be an all-round development of the child and man and at the same time it could pay a part of its cost through a productive craft. "*Nai Talim*" or Basic Education as he called it, had at its centre a productive craft, the end product of which could go to meet the daily needs of life and around which all learning could be woven. The social and natural environment of the child, its exploration and understanding became the concern of this scheme of Education. Through such a scheme Gandhi believed that Education could become real, purposeful and creative. So we started our basic school with a small number of children from the locality. As they completed the period of 8 years of education, we moved on to the next stage equivalent to the secondary level with agriculture as the centre of activity. We were ourselves planning the tier after this Post-basic stage, when the Government of India came up with the proposal of starting institutions of rural higher education in places where experimentation in rural education had already gone on. So the logical step to bring higher education to the very doors of the rural people, to meet the needs and challenges of rural communities and to provide access to the bright and deserving rural youth to higher education with a view to developing leadership in rural areas for their progress, became inevitable. Thus an unbroken continuum beginning from pre-school education and moving on to post-graduate education came to be established as a process of growth. The Institute of Rural Higher Education now enjoys the status of a University with autonomy to build its own curriculum and plan its activities, drawing the content and substance from action-oriented research and investigations in rural areas and feeding them back with the results of such investigations, thus paving the way for the blossoming of the economic, social and cultural life of the people in these communities. In order to implant these concepts and orient pre-school, primary and secondary education towards

this objective, we took up programmes for training teachers for pre-schools, primary schools and secondary schools, specially in rural areas.

Agriculture in rural areas does not provide employment to all categories of people in the village all round the year. Non-farm occupations are essential both for keeping the idle hands busy and for the supply of their daily needs. "Extinction of village industries", said Gandhiji, "would complete the ruin of the 7 lakh (1 lakh = 100,000) villages of India." Revival of *Khadi* (Homespun Indian cloth) and Village industries, improving their efficiency, providing training and facilities for rural artisans and educating them in non-exploitative technology therefore became a part of our committed objectives. In addition to running 84 village centres for Khadi spinning and weaving which provides employment for 350 weavers and 1,330 spinners in villages, training and education in Khadi and village industries programmes both at undergraduate and graduate levels have been organised to produce personnel for intensifying these programmes in rural areas both under Government and voluntary private agencies. Our Khadi production is just above Rs. 24 lakhs a year out of which an amount of Rs. 2 lakhs returns to the villages, Rs. 13 lakhs as wages for spinners and weavers, another Rs. 2 lakhs for their welfare projects and Rs. 6 lakhs to the farmers who produce cotton. Thus the Khadi industry returns nearly 83 per cent of its turnover to the village farmer and artisan.

The insanitary environment in villages, causing enormous damage to the health of the people, and their pitiable ignorance of this condition which could be changed by their own efforts, prompted us to undertake a study of the state of health of the villagers, plan a systematic programme for better sanitation and health education and train the personnel for this work. A Pilot Health Project therefore appeared on the scene as an experiment for a population of 100,000. As the work advanced, other important facts of rural India like infant mortality, malnutrition among women, need for limiting family size etc., halted us and demanded our attention. The Pilot Health Project had to expand its scope and functions to include everything about rural health and family

planning and plunge directly into field activities developing its strategies and methods, refining them again and again through systematic and sophisticated research. The experiences gained in this process are made available to Government and other agencies through short and long-term training programmes for their personnel. The Institute of Rural Health and Family Planning has demonstrated now that through a process of vigorous and effective education, the birth rate in a rural population of 100,000 could be reduced from 43 to 27 over a period of 15 years. While the Gandhigram Institute of Rural Health and Family Planning was training workers from all parts of India and South-East Asian countries at different levels in rural health and family planning, our hospital's activities began to extend beyond its compound. A hundred and fifty-bedded hospital, training auxiliary nurses, midwives and health visitors, attending to a large number of outpatients and with specialists' services, moves its medical personnel every day of the week to its chosen mini primary health centres each for a 10,000 population, to deliver health care services.

Rehabilitation of destitute women, and socially and economically handicapped women was an important part of our work. Giving them education up to the secondary level, training them in some gainful occupations and seeing them settle down in life, fulfil a social obligation we owe to society. Similarly, orphaned children, tender children left behind in hospitals and elsewhere, small boys and girls without family protection, seek an asylum in our Children's Home.

Thus Gandhigram has grown through these 30 years into a federation of welfare, education and training institutions providing opportunities for boys and girls, youth and adults to gain understanding and develop skills to function in different areas of rural reconstruction at different levels.

Right from the beginning we were in close touch with the villages around us, involving villagers in our activities and we participated in the many development programmes in these villages. This two way traffic over a period of 3 decades opened up new vistas for us to gain proper insight into the nature of

rural communities and made us realise the errors in our approach to rural development. The lessons we have learnt from our many attempts have convinced us that rural work cannot be carried out to set formulae and enunciated theories but should recognise the stark realities in which the lonely, the lowliest and the lost find themselves, and do something to make this category realise that they could liberate themselves from this situation to live better, taking their legitimate share with others as citizens of our Republic.

In the earlier days of the work, the girls under training used to camp in the villages for weeks. They carefully studied the sanitary and health conditions of the villagers and gathered the people to tidy up insanitary places, attended to minor ailments of the women and children, attempted some adult literacy and organised recreational and cultural activities. The villages looked cleaner during their stay, people enjoyed meeting the girls, talked to them and relaxed through the cultural programmes. As soon as the girls left, the villagers promptly returned to their earlier usual ways of life and living. The camp was a satisfaction to our *sevikas* (girl volunteers) under training, a change from normal routine to the villagers but made no durable impact in their sanitary consciousness and health habits. When the Government of Tamil Nadu initiated local development schemes, we undertook the responsibility of executing some of their programmes, put up school houses, sunk drinking water wells, laid *kutcha* roads and the like. These were projects planned by the local Government authorities and executed for the village people by contractors.

When in 1952, the mighty programme of Community Development was launched all over the country, Gandhigram at once felt that this was an opportunity to do rural work on a larger scale and much against the obloquy of orthodox Gandhian constructive workers and institutions, accepted the offer of the Government to train village-level workers and social education organisers. An area having a population of 300,000 spread over 3 blocks was entrusted to Gandhigram for development according to the pattern laid down by the Ministry of Community Development. It was

an intensively busy period for Gandhigram when scores of young and adult men were trained in successive batches, and hundreds of hamlets and villagers stirred into action in the construction of roads, school houses, digging of wells for irrigation and drinking purposes, installing electric motors, pumps, improving the quality of livestock, developing fisheries, etc. Gandhigram had the advantage of exposing its trainees to the field work going on around it and simultaneously improving the quality of field staff by bringing them to Gandhigram for short in-service training. Thus training and field work reinforced each other to make them both real and effective. The accent in the Community Development programme was largely on increasing agricultural production, owing to the food shortage.

In the earlier days, regular visits to neighbouring villages were arranged for groups of students and teachers for a village cleaning campaign. Week after week, on Saturdays, this group would visit the village with broomsticks, spades and baskets, clean up the roads, tidy up the insanitary corners, and dispose of the rubbish by burning or burying it. Here and there either some school children or some women would give a helping hand. When on one Saturday we could not visit the village but went there the Saturday after, an adult villager met us and asked us why we did not turn up the previous Saturday and told us that since so much of accumulated dust and rubbish remained to be cleared, we should work longer that day and complete the work. Well, here was our first lesson in rural extension service and here was our teacher to give us the first lesson in Community Development. The village community did not feel the *need* for a sanitary environment as much as we felt. The need was not theirs but ours and therefore their participation was nil. In later years as we put up buildings with funds from Government and other sources for pre-school education or provided other welfare amenities, we discovered to our disappointment and astonishment, that maintenance, care and proper use of these amenities were deplorably neglected by the villagers because they were never consulted, nor were they involved either in planning or in carrying out these activities. There was no participation by the villagers.

We came across numerous instances where people did not fully avail themselves of the benefits of the small projects we initiated in the villages because the order of priority of their needs were different from what we had decided. These experiences, at micro levels, we found reflected in a larger measure in the wider community development programme which covered the country.

The findings of a nation-wide survey conducted by the National Institute of Community Development (NICD), in 1966 revealed that people saw Community Development as a task-oriented programme, as opposed to a process-oriented programme. Although the people were involved by their contribution of labour they were never real participants. The act of participation instead of becoming a learning situation, dwindled to one of drudgery and even resentment. Many other minor factors contributed to the failure of the Community Development Programme. It is definitely due to this one factor of not getting the villagers immersed in the development process of education within development programmes that we can largely attribute the failure of the Community Development Programme. The need for development education for the people became obvious.

And so the Committee on Plan Projects more familiarly known as the Balwantrai Mehta Committee which probed and investigated thoroughly into the affairs of the Community Development Programme, made the far-reaching recommendation that "there should be devolution of power and decentralisation of machinery and such power should be exercised and such machinery controlled and directed by popular representatives of the local areas". In effect, rural development was linked up with local governments at the village level, to determine realistically the local needs which could be reflected in the plans of development. The *Panchayati Raj* (Village government) was expected to work at the grass-roots level involving the people of the village in planning and executing programmes to meet their felt needs. But even within the limited achievements of the working of the *Panchayats*, the masses of the people had been found to be generally ignored. There was no rural awakening nor public enthusiasm created to educate the people to participate. It is unfortu-

nate that the traditional rural leadership crept into the *Panchayats* at the elections. The Fifth Evaluation Report says that committees are usually dominated by the conservative upper class and prosperous elements in the village. The Balwantrai Mehta team felt that the economically weaker sections "have as yet little voice in the affairs of the *Panchayats*".

A strategy had therefore to be evolved to ensure participation of the members of the community in activities that could bring about a real change in their social and economic life. Participation, we felt, should not merely be contribution of some money, material or manual labour but should mean participation of those concerned in recognising the felt need, planning effective ways to meet them, and then with the resources available, carry out the activity to completion. This could be achieved by the people themselves, thinking and acting collectively or by those leaders acceptable to the people. We attempted to encourage both. The process consisted of:

1. a fact-finding survey of the status quo (socio-economic) of the people, availability of resources.
2. leadership survey to identify functional leaders.
3. village people assemblies, discussions on the existing conditions, recognition of needs.
4. village assembly meetings, constitution of village committees.
5. discussion with committees with the participation of officials of the *Panchayats, Panchayat* Unions, representatives of credit agencies.
6. meeting of the village committees for fixing priorities and a plan of action.
7. execution of the projects by the community with local resources and assistance from other external resources.
8. evaluation by the village committees.

For trying out this strategy we selected a group of 21 villages which were contiguous and were within a radius of 5 miles in Dindigul and Reddiar Chatram blocks. The priorities of work

as fixed at the village council meetings and by the leader — groups were:

1. development of dry farming.
2. supplementary occupations through milch animals, goats etc.
3. deepening of irrigation wells, sinking of new wells and installation of pumpsets.
4. *balwadies* (children's centres).
5. housing programme.
6. improvement of local artisans.
7. assistance to landless agricultural labour.

The project has gone on for over 5 years. An evaluation of the socio-economic changes that have happened during this period in this "Growth Centre Complex", as we call this group of villages, has been initiated.

During the period of 5 years the experiences we had gained, lessons taught to us by villagers and others, have been of considerable importance to us.

We tried to see the village as a unified or a unifiable community whose overall productivity needs to be increased. After a considerable amount of planning and field studies, efforts were made in improving irrigation facilities, producing agricultural inputs, setting up institutional medical care, starting village industries, *balwadies* etc. But we have doubts whether these efforts reached fully the bottom 25 per cent or whether it perpetuated the dominant 10 per cent group, buttressing and reinforcing their social and economic status. The rural power structure appeared to us to remain unaffected. We see the basic source of inequality continuing on the scene. Nearly 30 per cent of the people live at minimum subsistence levels.

The need for concentrating the efforts on the poorest sections of the community became more and more clear and obvious, if participation in its fullest sense is to be achieved. This would

mean that we should work directly with the exploited groups, the poor and the disinherited, promote understanding of the situation they are in, develop in them some self-reliance and encourage them to voice their rights through organised effort. In this direction also, we could make some efforts here and there to ensure that the lowest social strata became independent of the dominant groups for its vital needs like water. Since in these villages, the *Harijan* (backward) groups depended on the caste people for drinking water, the caste groups exploited this situation by paying them wages at rates very much lower than what was obtained in villages near about. This absence of a drinking water facility not only denied them the vital necessity of life but was also a source of economic domination by the landed village elite. The Harijans were kept in a state of perpetual dependency for their very survival. This position was corrected by sinking a well with the full participation of the Harijan group and the Harijan group realised the value of its liberation from its dependency on the caste people. They got the life-sustaining water, demanded the minimum wages and got them.

Often the question whether an economic programme in a village should precede a welfare programme, or vice versa, confronted us. The villagers answered this question intelligently by demanding economic programmes as a precursor to welfare programmes. So in places where we had introduced economic programmes through spinning activities and where such programmes have been going on for some years, we find better appreciation of the welfare programmes and fuller participation of the people in them.

This in short is the story of our work in villages. It certainly cannot be a 100 per cent success story. We began our work as a service agency to provide health services, welfare services and certain other physical amenities and facilities to villages through assistance from Government and other agencies. Then economic programmes through agriculture, Khadi spinning and weaving were taken to the villages. We gradually saw the village as a complex configuration of groups held together by traditional social forces, and economic interests. We sensed the interplay

of these forces and interests and tried through a process of education to awaken the people to see the realities and realise the strength in coming together to participate in activities and projects which would bring the needed change in their lives. The less privileged groups needed more attention and education. They needed recognition and respect as individuals. It is not easy to respect people because this means that we must be willing to listen to their point of view. Respect also means that we accept the fact that we can learn from other people. It is easy to do this with people coming from the same social background and sharing the same view we ourselves hold. But to listen to and learn from a landless labourer, a rural artisan or a Harijan cannot be easy and comfortable. It is far more easy for us to judge them from our social and economic positions and decide for them from our value-premises than to regard them as human beings who have something worthwhile to say. Participation is an intensely human experience.

Mahatma Gandhi showed this to us in our own generation by identifying himself with the "Daridranarayan" (poor people) and demonstrated that it could be done.

So, our effort is but a small drop in this ocean of problems in Rural India. We do live with an uneasy conscience whether we had put our minds and hearts fully into finding solutions to some of them at least. We have perhaps picked up some pebbles, but the boulders remain to be cleared!

EDUCATION AND RURAL DEVELOPMENT

THE INTEGRATED RURAL DEVELOPMENT PROGRAMME IMPLEMENTED BY THE MADRAS UNIVERSITY

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Every student studying in a college in the Madras University area must compulsorily devote himself or herself to Community and Social Service (CSS). Under the semester system of higher education introduced in 40 colleges from 1976–77, a student is expected to devote himself to community work for 2 hours per week in the first four semesters and 6 hours per week in the last two semesters under the guidance and supervision of the teachers. A small fee of Rs. 10 per year is collected from every student to cover the expenses under this programme.

The performance of the students is evaluated by the teachers in relation to their motivation, efficiency and involvement in the programme, and marks are awarded to them upto a maximum of 200. This is not considered for a pass under the major subject but it is added to the total marks for grading and classifying the students' academic work. About 30 more colleges will come under the semester pattern in 1977–78 and in a couple of years all the colleges in the University area will be covered by this pattern.

The overall objective of the programme can be stated in a single sentence: *Educational service to the community to effect a transformation in the thinking of the people.*

Colleges are encouraged to adopt a village which is undeveloped, lacking even basic amenities like drinking water. The college community is made to learn to work with and among the

people and engage itself in nonviolent social action. This confrontation with reality will enhance our knowledge of ourselves and the community in which we live. Our scholastic attainments can be put to practical use in mitigating a few of our social problems at least. The students of our colleges will gain the skills needed in the exercise of democratic leadership. This project will promote national solidarity and integration. The gap between the 'gown and town' will be bridged. It is expected that this project will reflect the values of democracy, secularism and nonviolence in public life.

The scope of the project is decided upon and developed after a discussion in depth with the leaders and the people of the village. Our academic ideas are not thrust on them. The plan of action is based on the *felt needs* of the community. The process of planning itself is part of the educational process of the student.

But it must be clearly understood that committing some additional resources under this programme is *not* the way it should be implemented. Of course the funds available can be used for the welfare of the community — installing a *Gobar*-gas plant, establishing a community centre for recreational purposes, establishing a community science centre, etc., The Block Development and *Panchayat* union staff can be invited to offer their suggestions and help in our plan of action.

Every department of the college has a useful role to play. Since the main concept is the socio-economic uplift of the poor and illiterate villagers, a preliminary survey should be made of the materials and resources already available. Collection and analysis of data in the following areas will be the starting point of the programme: Literacy including adult literacy, drop-outs from elementary and secondary levels, malnutrition, rural income and indebtedness patterns, strength of the family and impact of the family planning programme, employment pattern, leisure-time activities and the like.

Organisation of medical relief with qualified and committed medical personnel will effectively contribute to the better health

and well-being of the people. Games and sports can be organised since every college has a Physical Education Instructor.

A scientific, systematic and integrated use of all resources available — human and material — within the college community must be planned.

The broad spectrum of activities could be listed as follows:

1. To activate all people in the village belonging to the age group 15–60 years.
2. To draw them into the mainstream of national economic activity.
3. To improve production and productivity.
4. To put land resources to rational use.
5. To use water resources scientifically.
6. To increase the output of essential food crops and fibre through scientific farming.
7. To improve the diet, health and educational attainments.
8. To plan employment for agricultural labour during the off-season (*e.g.,* by processing agricultural raw materials and waste materials during the off-season).
9. To plan and attain minimum standards of productivity or efficiency.
10. To instil in the people, the idea of trusteeship of private property.
11. To develop a scientific temper among the people (change in thinking and change in old habits and thoughts).
12. To fight superstition and eradicate water-borne and communicable diseases.
13. To fight socio-economic oppression.
14. To modernise agriculture where possible.
15. To produce an impact on the minds of the people in relation to their day-to-day activity — sanitation, health, nutrition, family planning, dietary habits, etc.

RURAL DEVELOPMENT WORK CENTRE
ESTABLISHED BY COMMITTEE ON SCIENCE AND TECHNOLOGY IN DEVELOPING COUNTRIES (COSTED)

DR. S. RADHAKRISHNA,
Scientific Secretary, COSTED.

INTRODUCTION

COSTED (International Council of Scientific Unions' Committee on Science and Technology in Developing Countries) has been interested in the problems of developing countries, with particular reference to the application of science and technology for the rapid development of the developing countries. It has been organising a series of seminars and meetings on this aspect in various developing countries. In addition, it has been making an in-depth study of various problems which tend to slow down the development of these countries. It has examined in detail the Role of Universities in National Development (Meeting on Role of Universities in Scientific Development, Colombo, Sri Lanka, January 1975, COSTED Report), the Role of Science Education in National Development ('Science Education in Developing Countries,' December 1973, COSTED Report), and the Role of Science Education in the special context of Environment (Regional Meeting on Mineral Resources and Environment in Developing Countries: The Role of Science Education, Kuala Lumpur, Malaysia, April 1976 and Regional Meeting on Resources and Environment: The Role of Science Education, Ghana, August 1975). In this context, a study has been undertaken and a report prepared on 'Technological Education in Developing Countries' (May 1976, COSTED Report). Under contract with UNESCO, COSTED has also prepared a report on 'Training of Engineers, Technologists and Technicians in Developing Countries' (April 1976, COSTED/UNESCO Report).

As a result of all these studies, personal contacts made, discussions held and reports prepared, a major conclusion that has emerged is that the broad educational pattern, as is now obtain-

ing in many developing countries, is not relevant to the needs, the socio-economic climate and the aspirations of the people in the developing countries. It has been pointed out that the engineers and scientists now being trained as 'finished products' are totally devoid of actual rural work experience and direct knowledge of the needs of the people and the kind of resources that are locally available. They constitute an elite, removed from the people and their problems, and they always look for white-collar jobs in urban areas. An actual survey made in developing countries confirms this. The programs and projects initiated and backed up by the expertise and by the background of such an elite no doubt benefit a few people at the higher echelons of society but do not affect the lives of the vast populations in the lower echelons, that live in the rural areas. Benefits of technology, flowing mostly into heavy industries like the aero-or automobile industry, do not reach the common man and he thus remains largely untouched by technological advances. Moreover, even the welfare schemes have in the past not been directed purposefully to make advances in sciences meet the basic needs, such as drinking water, food, shelter, clothing, health, employment and literacy of the rural populations.

The reports prepared for COSTED show that, among other things, the primary reason for this situation is the inadequate and inappropriate exposure and training of students. While young, they get no opportunities to become aware of the problems faced by the vast rural populations of the developing countries. It was felt that COSTED should take the initiative, in setting up a pilot project in a typical developing country where the rural populations are still in a developing state with the objective of implementing the conclusions and recommendations of its studies and assessing the effectiveness of such a pilot project. This pilot project will have the primary aim of educating chosen young people to help rural populations raise their overall standard of living and quality of life in a typical area, where they actually live, by the appropriate use of science and technology. For reasons of convenience of operation, a semi-rural area in the vicinity of Bangalore has been chosen for the initial pilot project. If this experiment proves successful, the methods adopted, the lessons

of experience and the results of assessment will be extended to areas in other developing countries. In this sense, this project is to be viewed as an experimental pilot project which is being operated under the direct supervision of the Secretariat of an International Committee, COSTED. By using the suggested methods, we hope to correct the imbalance—or at least demonstrate that it is possible — in the finished product of the present educational system. Keeping in mind the basic human needs of people this project has, for its principal aim, the objective of improving the quality of life of a small chosen section of people. As an experiment we have chosen a small rural community, of population 1500, on the outskirts of Bangalore.

PLAN OF ACTION

The centre has been trying to expose and educate chosen young people to what is relevant in the context of the common people and to help the latter use science and technology to raise their standard of living and the quality of life of the community as a whole. Keeping in view the basic human needs, the centre will concentrate on making the people provide for themselves, nutritious clean food, cheap and durable clothing, basic health requirements and low-cost housing. In addition to devising methods of providing these basic amenities, it is also expected that the centre will provide meaningful employment to the able-bodied youth of the area, thereby providing suitable occupations for them. As can be seen from the flow-chart, adequate training will be provided to people at different levels of education. The centre will aim at overall development by an integrated approach with science and technology as the basis.

STAFFING

Technical Director (*One*): He will be in overall charge of the rural work centre. He should have experience of rural problems and should be a scientist of repute with a human approach to problems. He will be given a salary of Rs. 1,500 per month. This position has not been filled so far.

STAFF POSITION FLOW CHART

RURAL TECHNICAL WORK CENTRE

↓

Technical Director

↓

Food and Agricultural Division	Health and Sanitation Division	Housing and Construction Division	Textile Division	Machine Technology Division
↓	↓	↓	↓	↓
Consultant Manager	Consultant Manager	Consultant Manager	Consultant Manager	Consultant Manager
↓	↓	↓	↓	↓
2 Graduates	2 Graduates	2 Graduates	2 Graduates	2 Graduates
5 Intermediate education holders	5 Intermediate education holders	5 Intermediate education holders	5 Intermediate education holders	5 Intermediate education holders
8 High School leaving certificate holders	8 High School leaving certificate holders	8 High School leaving certificate holders	8 High School leaving certificate holders	8 High School leaving certificate holders

PLAN OF OPERATION:

Start 1 January, 1977 → 3 months orientation programme for all trainees → 12 months training production by 15 trainees in each division

→ 3 months of overall Survey of needs → 6 months of specific task allotment to each division

→ End of project Phase I 31 December, 1979.

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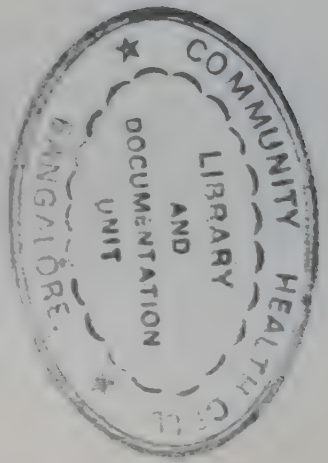

Technical Managers (Five): One manager each will be attached to the five divisions of the centre and will be responsible for the day to day working of the centre. Each manager will be given a salary of Rs. 800 per month.

Trainees (Seventyfive): Each division has 15 Trainees in number. These trainees are of three different categories.

(*a*) Two of them are graduates with considerable academic knowledge. In the process of the training, they will become exposed to, and acquainted with, problems of the rural population. Each of them is being paid a monthly stipend. These graduates will, in certain fields, bring to the rural area a fresh approach based on the advances of science and technology.

(*b*) Five of them are of intermediate academic training and after training in the rural areas, they will be encouraged to obtain further educational qualifications in the field in which they have received practical training at the centre. Each of them is being paid a monthly stipend.

(*c*) Eight of them are of the school-leaving level and would not yet have been exposed to various aspects of technological training. They will first be given an overall orientation programme for three months after which they will be attached to one of the five divisions of the centre. After experience for the remaining period they will be sent for higher education in the same area and will be reabsorbed by the centre after appropriate training. Care will be taken to select the right academic institution for this type of training. Each of these trainees is also being paid a monthly stipend.

CONSULTANTS

Provision is also made for one consultant (part-time) in each division. This consultant will be drawn from a nearby industry/ educational complex/agricultural university, etc.

THE EXPECTED IMPACT

1. The rural work experience would be an orientation for 70 or more key youngsters every year.
2. The knowledge of this experience will be shared amongst a number of academic institutions, from which the graduates will be drawn and would go to later strengthen the programme. In the present scope of the programme, this will be shared in the colleges where the rural workers (RWs) will go for post-graduate work.
3. Educative aspect: This programme would have informal, direct and indirect developmental impact on a block of rural population numbering about 2000.
4. There is scope for improvement in village sanitation without any effort on the part of the Government, or any other external agency.
5. There is similar scope for improvement in sewage disposal and treatment.
6. There could be effective reportage of disease and other statistics. This will prove to be a direct test of the impact of science and technology on the rural population.
7. The teaching and demonstration of First-Aid implementation and practice, would be carried out.
8. There would be an effort at improvement in agricultural productivity. A model agricultural farm will attempt to demonstrate the advantages of scientific farming.
9. Actual production of food and foodgrains by RWs and running of a model farm, would be carried out.
10. There would be early implementation of grain production development techniques among local farmers, by effective explanation, practical demonstration and translation into action.
11. Workshop, social and agricultural experience would be given to the RWs.
12. A Rural Repair Center for agricultural implements which are already available with local farmers, would be set up.

13. The rural society would have an educated partly motivated and fresh observer group identifying areas requiring developmental concentration.

14. Personalised explanation would be carried out regarding activities like family planning, hygiene, communicable diseases, etc. The expected returns on this aspect are very high.

15. The centre will aim at overall and uniform growth of the standard of living of a selected rural community. This is a parameter which is quantifiable.

RESULTS AND LESSONS LEARNT FROM THE PROJECT

The Rural Technical Work Centre has been in operation now for about a year. During the year the attempt has been to strengthen the talents that are already available in the rural community. For instance the main economic activity of the area is weaving. In the project we have engaged two specialists who are concentrating on improving the quality of the fabric that is prepared. The biggest bottleneck in making this the main economic base of the village is the aspect of marketing. The fabrics prepared by the rural community are not getting into the mainstream of the urban market until they pass through the urban manager or middle-man. As this middle-man has a strong hold on the market, he buys the material from the actual weaver and passes it on at a much larger profit to the shopkeeper, who in turn sells it at an even higher price. To correct such market trends is a far more involved task and the help of economists and management experts is being sought.

Another important aspect is the social confidence gap that one has to face in such a programme. The initial reaction of a rural community is one of distrust and they do not like the patronising manner in which conventional rural development programmes are operated. What appears to be the most difficult and in fact the most crucial step is the building up of the confidence of the rural community. At least during the initial stages the rural development programme should aim at improving the existing

skills rather than transferring technology which has doubtful benefit to the community.

An area in which great success has been achieved, by the programme, is public health education. In the rural community chosen there have been a number of cases of night blindness (caused by vitamin A deficiency), hook-worm, protein-calorie malnutrition etc. Effective and timely treatment coupled with nutritional education has restored sight to several children and the grateful parents have learnt to regard the project as one which can do a lot of good to the community. Several of these child diseases are not due to poverty or hunger. These are due to ignorance and can be rectified by a coordinated approach. In fact it has given us confidence that if nutritional and health problems are tackled on a war footing, many ills of developing countries can be rapidly overcome.

In order to make an effective impact, we have prepared a large number of colour slides and charts with local language commentaries to explain, in simple terms, the consequences of malnutrition. In the medical sub-centre we have trained three "bare-foot doctors" who will draw the attention of doctors to the specific health problems when the doctors visit the area periodically. This health education aspect has been extremely useful and it is hoped that this preventive aspect will serve the community well in the years to come.

Fortunately the village has an exceedingly good and clean water supply facility but because of ignorance young children walking in slushy areas are not kept clean and they contract diseases due to hook-worms and other parasites which suck out a great deal of blood. With considerable training, this has been partially corrected so far. Rural electrification and power generation also does not seem to be a major problem at the moment. The area is electrified and there is sufficient power available. It must also be admitted that the division on Housing has had many lessons to learn. The concept of low-cost housing does not seem to have much relevance to the rural areas as they have exceedingly good "houses" built at practically no cost and they are more

than happy with their homes. However what requires priority-attention is the general habitat, which includes the unclean surroundings. This leads to ill-health and problems of sanitation.

The importance of letting the community choose its priorities, its needs and requirements cannot be overstressed. This is most essential during the initial period of any project on rural development. It might give the feeling that progress is slow and might make us feel that the rural community does not know its priorities. However, this will pay rich dividends in the long run and is well worth "slow" initial progress. Actually I have now come to believe that it is this aspect that stands between the success and failure of a rural project. In this project the management committee consists of five local persons with one representative from outside who is there more to report the details of the discussions rather than influence the discussion itself. This approach has again paid rich dividends and has been extremely useful in the building-up of confidence, which is so vital for the success of the project.

PROGRAMMES OF THE ASIAN INSTITUTE FOR RURAL DEVELOPMENT (AIRD)

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The heaviest concentration of absolute poverty is in Asia, particularly in that part of the Asian region covering India, Pakistan, Bangladesh and Indonesia. This stark reality becomes more fearsome when we realise that these human problems grow in magnitude daily as the population expands at the present rate of 2 per cent a year, despite the high rate of migration of rural people to urban areas.

As the Asian countries emerged as politically independent nations during the past three decades, they adopted development models which according to candid post-mortem critiques have led at times to appalling results. The general features of these models were :

(*a*) Industrialisation
(*b*) Assistance from developed countries
(*c*) Import of foreign technology
(*d*) Isolated and uncoordinated programmes
(*e*) Central planning, control and co-ordination.

(*a*) *Industrialisation*

There is no doubt that industrialisation has created growth and also an affluent class of people. Alienated from the great bulk of the population, the interest and contribution to rural development by the latter was but superficial. Rarely frugal, much of their consumptive expenditure is on foreign rather than domestic goods. The hope that the benefits of industrialisation

would trickle down, and the rural sector would be carried on the back of the urban industrial sector has not been fulfilled.

(*b*) *Assistance from developed countries*

Foreign assistance may also produce some growth, but it also results in unequal distribution of the benefits. Such assistance has been of questionable value in the national context, when its effect is subservience, or erosion of the spirit of self-reliance.

(*c*) *Import of foreign technology*

By dependence on foreign technology, the growth of appropriate, indigenous technology was prevented. Poor development of human skills leads to under-utilisation of human capital. An industrialisation based largely on technology available off-the-shelf from advanced countries can hardly motivate our people to adopt newer technologies and improve their skills and productive efficiency. Mobilisation of people, who are the richest resource of Rural Asia, for conversion of surplus labour into means of production, implies evolution of appropriate indigenous technology to fit in with the labour-intensive strategy.

(*d*) *Isolated and unco-ordinated programmes*

When uni-sectorial or even multi-sectorial programmes are undertaken by several agencies without prior consultation and discussion, the result is that a number of parallel organisations operate in the same area, often duplicating efforts. Monitoring, people's participation, overall efforts for evaluation or for co-ordination are impossible in such cases, and there is no mechanism for follow-up activities when a project or programme is heading towards closure.

(*e*) *Central planning, control and co-ordination*

The concept of rural development should be understood in terms of fundamental humanistic values rather than the narrower techno-economic notions. In a purposeful growth of human personality and release of the creative, human potentials, for

mobilisation for development, lies the key to success. The individual and collective personality of society standing for self-confidence, poise, purpose and pride, are the real ingredients needed to strengthen the base for rural development. All these mean self-reliance, which ought to be the nation's real purpose. There is no place for soft options here. If liberation of human potential and its nurturing are essential to exploit our rich human resources, we have to develop massrooted and inspirational leadership, along with effective participation of the rural people in planning, implementation, monitoring, and evaluation. The leadership ought to be not only individual but collective, and homogeneous in terms of values, attitudes and strength of character, free from hangovers from elitism, bureaucratic administrative styles, traditional taboos and the like. The system to be practised must be in the open and is seen to be just.

Leadership by itself can achieve little or nothing if a radical change is not effected in mass consciousness. The consciousness is latent, but it can be, and should be roused. It has to be roused before the change is initiated. Without such preparation of the peasants and other sections of the rural poor for co-operative and collective work of all kinds, there can be no stimulus for participation. The urban elite, with dedication and experience, could be a great help in this context, provided these elite people share the village life, becoming useful to the rural people, and acceptable to them. Social transformation is not a simple process, but is never-ending, and can never be achieved by a few thrusts or by only a minimum obeisance to the development concept.

All these basic pre-requisites did not form parts of the central plans developed by the developing nations, with the result that change went ahead of mass consciousness; the leaders became alienated from the rural people; and the programmes remained as those imposed from above, to be accepted as a form of charity if it appears useful, and to be kept at arms' length if it is otherwise. The expectation that a standardised plan for a nation can fit into all ecological and social situations, and can be operated through normal or special administrative channels, with plenty of subsidies

and grants thrown in, did not materialise. In a word, the planning was not done at the grass-roots level, and there was an utter lack of participation, if not apathy, by the rural people. The programmes therefore, were all a failure in bringing to the people a higher and satisfactory quality of life.

SUM-TOTAL OF PAST EFFORTS

The results of all the past development efforts have, therefore, been pitifully trivial and transient. Spurts of development such as that under the "Green Revolution" benefited only certain pockets or areas, with benefits flowing mainly to richer farmers who had pre-emptory access to the inputs and the necessary credit, thus exacerbating the problems of inequality and enabling the polarisation to grow even more in rural areas. Even the basic needs of the vast majority of the rural people for food, habitat, health and education are not being met today in rural areas fully or adequately, 'stuck in deep mud', says one United Nations paper, and a massive re-direction and thrust to lift the wheels up and set these moving again, is an urgent task.

AIRD'S PROGRAMMES

AIRD's activities are based on the hope that it would be able to participate actively in this process of re-direction and thrust of social and economic effort. To help the rural people to understand and master their social and economic environment, is AIRD's objective, as much as to assist them to meet fully their basic needs for food, habitat, health, education and the like. AIRD is eager to join hands with all other agencies in providing the constellation of favourable conditions for fulfilment of all the economic and social aspirations of the rural people. AIRD will endeavour to inculcate the need for self-reliance and reject all soft options. It seeks to achieve the objectives through the co-operation of agencies and the rural people, by supplementing and complementing the efforts of all others, rather than by competition or duplication of efforts. Cooperation in planning, monitoring, self-evaluating, coordinating and implementing is its working principle. In the search for practical solutions to the numerous

challenging problems in many fields, problem-oriented research and result-oriented field action projects will be undertaken with the co-operation and, if necessary, collaboration of any one or more other agencies.

As a non-governmental organisation, it intends to follow flexible and innovative methods. It is a regional institute, autonomous, non-political, non-sectarian, non-denominational and non-commercial. It seeks to build action and research partnership among national, regional and international institutions in both developed and developing countries.

The Institute is sponsored as a Charitable Trust under the Indian Trust Act, 1882 and was registered in 1976, at Bangalore.

Its present Board of Trustees is comprised of eight persons from Sri Lanka, Thailand, Philippines and India with Mr. A. T. Ariyaratne, President of Lanka Jatika Sarvodaya Shramadana Sangamaya as Chairman, Dr. Puey Ungphakorn, Chairman, Thailand Rural Reconstruction, Bangkok, as Vice-Chairman, Mr. M. V. Rajasekharan, former Member of the Indian Parliament, as Executive Trustee, Dr. Ralph W. Cummings, Chairman, Technical Advisory Committee of the Consultative Group on International Agricultural Research, Washington, D.C., USA, Dr. M. S. Swaminathan, Director-General, ICAR and Secretary, Department of Agriculture, Research and Education, Government of India, Miss. Belen H. Abreu, Executive Trustee, Ramon Magsaysay Award Foundation, Manila, Dr. K. C. Naik and Mr. M. S. Ramaiah of India as members.

ACTIVITIES

Its current activities are briefly listed below:

. **Projects**

Research: (1) How to change the motivation of rural people to become self-reliant.

(2) Assessment of vocational training required to equip rural people for expanding and exploiting employment opportunities.

(3) Identification of problems and gaps for rural development in a backward area.

(4) Evolution of low-cost, appropriate, indigenous technology for rural areas.

(5) Mini-kit industries as subsidiary occupations for dispersal in the rural areas.

Training: (1) Establishing a vocational training institute.

(2) Establishing a training institute for rural development workers.

Action(pilot): (1) Integrated rural development in a backward area.

(2) Rural settlement with Rur-Ban Homes.

Workshop: (1) A national and regional workshop to evolve action and strategy for integrated rural development.

Publications: (1) "Rural Asia" will be published as a quarterly publication.

(2) Leaflets on rural occupations will be released.

Award: Annual Asian awards are proposed to be made for outstanding contributions to rural development.

An Institution is an expression of collective personality evolved out of collective action, experience and decisions. AIRD has emerged out of these processes to meet the challenges of the largest group of the absolute poor, in the Asian region. It hopes to work for rural development with a democratic approach, in which the leadership and the masses would move in a mutually interacting process.

ROLE OF AN AGRICULTURAL UNIVERSITY IN RURAL DEVELOPMENT

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When India became free it was faced with acute food shortage along with other political problems. The first Education Commission headed by Dr. S. Radhakrishnan, while analysing the situation then existing in rural India, the backbone of the country for food production, recommended the establishment of rural universities. Subsequently the reports of the Joint Indo-American Teams suggested the establishment of Agricultural Universities on the model of Land Grant Colleges/Universities of the United States. Based on these recommendations the very first agricultural university was started at Rudrapur, Uttar Pradesh (U.P.) in 1960. Similarly in the early sixties a number of agricultural universities were started in Orissa, Andhra Pradesh, Mysore (now Karnataka), Punjab and Madhya Pradesh, etc., with a view to impart agricultural education oriented towards technologies for agricultural production and productivity and to extend them to the rural people. To-day there are 22 agricultural universities, at least one in most of the states (Maharashtra and U.P. have four each) with two more in the offing in Jammu and Kashmir and in the North-Eastern States.

Agricultural universities are innovating institutions in which teaching, research and extension are integrated. Strategies for rural development are part of their activity. What follows is an account of such activities of the University of Agricultural Sciences (UAS), Bangalore which started functioning from 1965.

DEVELOPMENT AND COMMUNICATION OF FARM INFORMATION

One of the activities of the university is to bring out joint publications every year on the various farm practices on the recom-

mendations of the university scientists in collaboration with the State Government departments, in the regional language and in in English.

Additional programmes include:

(*a*) Printing folders in regional languages on important farm practices
(*b*) Publishing small booklets on scientific agriculture for the use of farmers
(*c*) Printing brochures on specialised topics
(*d*) Publishing feature articles in newspapers
(*e*) Publishing weekly question-and-answer columns in local newspapers
(*f*) Giving news releases to the press
(*g*) Periodical radio broadcasts
(*h*) Participation in exhibitions.

FARM ADVISORY SERVICE

The teachers, research and extension workers provide the farm services like (i) replies to farmers' correspondence (ii) attending to the office calls-both personal visits as well as phone calls and (iii) providing advisory visits to the farmers' fields on request (Table 1).

TABLE 1

Yearwise progress in Farm Advisory Service

Year	No. of queries received and replied to	No. of advisory visits made to farmers' fields
1966–67	134	125
1967–68	396	25
1968–69	340	53
1969–70	1,294	199
1970–71	2,527	291
1971–72	2,151	200
1972–73	2,397	148
1973–74	2,489	120
1974–75	2,859	276

FIELD EXTENSION WORK

The university has established field extension education units in four regional research stations located at Bangalore, Dharwar, Mandya and Raichur. The Bangalore unit covers 19 taluks (sub-districts), while the remaining 3 units cover 10 taluks each. In each of the units, agricultural graduates designated as Extension Guides are provided at the rate of one per taluk. These extension guides are equipped with motorcycles for quick mobility and are supported by a team of specialists.

The field extension activity consists of (Table 2):

(i) *Conducting adaptive trials:* The university scientists carry out this work in co-operation with the staff of the State Department of Agriculture.

(ii) *Establishing early demonstrations:* Before any new technology is widely popularised by the University it is necessary that the State Development System not only has an opportunity of observing the performance of a prospective technology under field conditions but is also convinced of its utility and of its practicability in application in the state. It is for this reason that the university extension units conduct early demonstrations which help local extension functionaries to observe, criticise, learn and practise the new technology and also assist some of the progressive farmers to go through the same process as adopters of new information.

(iii) *Whole farm demonstrations:* Under this programme selected farmers are enrolled as Whole Farm Demonstrators with whom the university scientists work for a period of 3–4 years and assist the farmers in all-round development of the farms. The specific objectives of this programme can be stated as:

(*a*) to encourage Whole Farm Demonstrators to take up improvements on all the crops
(*b*) to assist farmers to develop other subsidiary enterprises like dairy, poultry, sericulture, etc.

TABLE 2

Progress of activities undertaken under limited field extension work during the last decade by different extension education units of the University.

	No. of adaptive trials conducted	No. of first stage demonstrations conducted	No. of whole farms established*	No. of block demonstrations**
Extension Education Unit, Bangalore.				
1967–68	—	1,821	—	—
1968–69	—	1,334	—	—
1969–70	—	2,025	—	—
1970–71	182	1,142	—	—
1971–72	209	694	18	—
1972–73	176	310	31	—
1973–74	144	282	29	5
1974–75	265	625	14	17
Extension Education Unit, Dharwar.				
1971–72	58	330	9	—
1972–73	59	283	16	—
1973–74	77	232	16	—
1974–75	73	236	23	2
Extension Education Unit, Raichur.				
1973–74	—	—	—	—
1974–75	40	32	6	1
Extension Education Unit, Mandya.				
1974–75	63	23	—	2

*This programme was started during 1970–71
**This programme was started during 1973–74

(*c*) to educate farmers in order to make them farm-account conscious so that farm accounting can be used as a tool for stimulating thinking relating to their farm development

(*d*) to help farmers in improving their total economy.

(iv) *Block demonstrations:* This innovation is a mini-village-adoption programme where both big and small farmers in contiguous areas are involved, roughly covering 25–50 acres. The work consists of organising educational meetings for the farmers, well ahead of the season, conducting bench-mark surveys, staging method demonstrations, making available inputs for demonstrations at farmers' cost and frequent follow-up visits to take care of the operations, administration and individual problems and to suggest the measures to overcome them (Table 3). This programme also provides an opportunity for collaborative efforts with different agencies like the university, development departments, input-supplying organisations, financing agencies, etc.

TABLE 3

Some Results of Summer 1975 Block Demonstrations

Village	Crop	No. of Farmers	Area in acres	Average yield/acre (Kg)		Percentage increase over-Bench-mark
				Bench-mark year	Demonstration year	
1	Paddy	45	43.13	2172	2897	33.3
2	Paddy	87	110.00	1550	2830	82.0
3	Paddy	49	57.11	1296	2015	56.0
4	Paddy	50	92.20	2262	2549	12.7
5	Paddy	52	85.00	2110	2660	26.0
6	Paddy	58	61.00	1750	2790	59.0
7	Paddy	30	51.20	692	1520	119.0
8	Paddy	30	30.06	669	1126	73.5
9	Paddy	31	33.21	1440	2400	66.0
10	H Jowar	28	29.00	584	770	31.8

(v) *National demonstration:* This is an Indian Council of Agricultural Research (ICAR) scheme which was in operation in the five districts of Bangalore, Coorg, Shimoga, Belgaum and Raichur from 1971–72 and is now in operation only in three districts, *viz.,* Chickmagalur, Dharwar and Raichur (Table 4). Under this scheme, subject matter specialists work in each of these districts and establish national demonstration plots in the farmer's fields, which will be the first line demonstrations in the area.

FIELD DAYS ON RESEARCH STATIONS

The university has 41 research stations and they organise field days for the benefit of farmers and extension workers once a year to show the on-going research programmes, particularly those which have important practical applications. At the same time these field days help to get feed-back, both from the farmers as well as extension workers, about the important farm problems of the different areas.

TRAINING EXTENSION WORKERS

The university has taken leadership in organising various types of training programmes for the benefit of extension personnel of the State Departments of Agriculture, Animal Husbandry and Veterinary services, Fisheries and Horticulture. The types of training programmes developed include:

(i) Field-oriented short-term training programmes on the demonstration plots

(ii) Problem-oriented training programmes at research stations

(iii) Staff courses for senior officers of the department, and

(iv) Specialised integrated courses in subject-matter and extension.

TABLE 4

Number of National Demonstrations conducted from the inception of the Scheme

Year	Number of Specialists in position	No. of national demonstrations established			Total
		1-Crop	2-Crop	3-Crop	
1	2	3	4	5	6
		Bangalore			
1971–72	2	—	7	8	15
1972–73	4	2	17	5	24
1973–74	4	12	12	—	24
	TOTAL:	14	36	13	63
		Shimoga			
1971–72	4	9*	18	—	17
1972–73	3	16	11	—	27
1973–74	3	8	11	—	19
	TOTAL:	33	40	—	73
		Coorg			
1971–72	1	—	10	—	10
1972–73	2	3	9	—	12
1973–74	2	14	2	—	16
	TOTAL:	17	21	—	38
		Raichur			
1971–72	3	1	15	1	17
1972–73	3	3	16	1	20
1973–74	3	8	14	1	23
1974–75	3	—	19	—	19
	TOTAL:	12	64	3	79
		Belgaum			
1971–72	3	4	10	—	14
1972–73	3	6	11	—	17
1973–74	3	1	11	—	12
	TOTAL:	11	32	—	43
		Dharwar			
1974–75	3	6	9	—	14
		Chickmagalur			
1974–75	2	9	10	—	19

*Sugarcane

FARMERS, TRAINING INSTITUTE

A centrally sponsored Farmers' Training Centre located in Bangalore District is meant, for organising training courses, both institutional and non-institutional, for farmers and farm women. This farmers' training programme helps the university to keep contact with young and progressive farmers and also assists in getting some type of feedback on farm problems, to the scientists.

OPERATIONAL RESEARCH PROJECT ON DRY-LAND AGRICULTURE

Dry-land agriculture constitutes nearly 80 per cent of the States' cultivated land area and the research in this field will benefit the small farmers. The dry-land agriculture project of the university at Bangalore has come up with valuable research findings with regard to the introduction of improved varieties, crop patterns, land development, fertilizer application and plant protection measures. These have been put into practice in the villages of Singanayakanahalli, Honnenahalli and Rajanakunte covering an area of 240 hectares (ha). During the first year, 1976, information on basic resources was collected and it was observed that 60 per-cent of the families had less than 2 ha of land and another 30 per-cent had between 2–4 ha. To demonstrate the value of land shaping, land shaping activity was undertaken entirely at the cost of the project. Graded border strips in about 6.2 ha of land together on three individual holdings were developed using tractor power at a cost of Rs. 950 per ha. This convinced the other farmers about the usefulness of the graded border strips and resulted in their agreeing to take to this type of land development in their own fields with the technical guidance of university scientists. Graded bunds were formed as an alternative to contour bunds with a provision for safe disposal of excess of water, at an expenditure of Rs. 150 per ha. Similarly, the bedding system, which is a simple method for conservation and disposal of excess water, was also developed.

27 demonstrations showed the superiority of PR-202 and Indaf Ragi varieties over locals in yields, sometimes as high as 100 per cent. Similarly, DH-101 maize was introduced where

Deccan Hybrid was common so far. Cow pea C-152, red gram Hyd-3 and groundnut BH-8-18 were also introduced into the area. Farmers in the locality generally adopt broadcasting, though drill sowing is recommended. Seed drills and bullock-drawn wooden levellers, sprayers and dusters for plant protection were prepared and supplied to the farmers on a hire basis. Another feature of the project is that the farmers were introduced to the concept of community grasslands with the development of 0.5 ha of *gomal* land into grassland. The villagers, after being convinced about its development, agreed to develop more grassland by this technique further.

AMBULATORY CLINIC

One of the activities of the Veterinary Faculty in the service of the rural community is the mobile ambulatory clinic in which the students along with a competent teacher, treat the farm animals. A well-equipped clinic moves to any rural area immediately at the request of the farmers.

STUDENTS' INVOLVEMENT IN RURAL DEVELOPMENT

(i) *Project on Integrated Rural Development:* This has the broad objective of developing a model for planning for integrated rural development at the grass-roots level, using the techniques developed in the field of Regional Science, which involves systematic identification and analysis of problems of regions and to suggest solutions. It is envisaged here

(*a*) to collect information needed for an integrated plan for a demographic social area

(*b*) to develop specific goals of planning (using the above data) socio-economic activities of the area with major emphasis on creating employment opportunities for the residents

(*c*) to work out an integrated plan which includes specific operational projects for different development agencies to implement if they desire to do so.

In this connection it may be mentioned that the ICAR has, last month, selected Tumkur District in Karnataka for rural development. The UAS project is limited to a *hobli* in Bidadi, Bangalore District, and attempts to develop an inventory of resources more in line with the latest developments in regional science through the involvement of students and teachers of all disciplines of the university. It is also intended to develop work plans which would serve as blue-prints for State Development Departments and other voluntary agencies for implementing them in the area.

The demographic area consists of 52 villages which have closer social interaction for their service needs and for their economic activities. The list of subject matter areas which can be handled by the various disciplines of the university have been identified and the areas have been divided into specific problem areas and have been assigned to post-graduate students and teachers for collection of data.

From the next year it is proposed to develop a specific plan of projects to solve the problems identified after analyses of the data so collected.

The third stage would be to integrate these different plan projects with reference to the goals of integrated rural development which would be developed after reviewing the analyses of the data as a whole.

(ii) *National Social Service Camps:* The university has also been conducting National Social Service (NSS) camps for the last two years in each of the educational campuses of the university, *viz.,* Bangalore, Dharwar, Mangalore and Raichur, involving the students in the rural development activities during the trimester breaks. The Bangalore campus has selected villages in the neighbourhood of Besent park, Doddaballapur; the Dharwar campus in Munovalli area of Dharwar Taluk; the Mangalore campus in Jeeppinamogaru; and the Raichur campus in Yaragara. In all these, students, in addition to doing *shramadaan* (offering manual work) have been assisting the local residents in farm opera-

tions, making use of recent technological developments. Some of the activities of the Agriculture students are: bunding, compost making, super digest compost making, fertilizer application, plant protection measures, demonstration of threshing methods, rodent control measures, seed testing, etc., and of the veterinary students are: immunization of farm animals, conducting pregnancy tests, treating the common live-stock diseases, etc.

In conclusion, it should be emphasized that the need of the hour in all developing countries is to undertake rural development to improve the living conditions of the rural community by improving the economic status and also to create the employment potential to prevent a large-scale exodus of the rural population to the urban agglomerations in search of employment. In this process various agencies like the Government, autonomous institutions like universities, and other voluntary organisations are participating, each in its own domain. The agricultural universities, which have come into the picture recently, are also playing their humble role in fulfilling this objective. The foregoing narration of the various rural development activities of one of the agricultural universities in India would serve, it is hoped, as an example to other developing countries which may need guidance in their endeavours to improve their own rural communities.

SCIENCE AND TECHNOLOGY FOR RURAL DEVELOPMENT

ROLE OF INSTITUTIONS OF HIGHER LEARNING

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INTRODUCTION

In this paper we will discuss the role of institutions of higher learning — Universities and National Research Laboratories — in relation to problems of national development, those relating to rural development in particular. After discussing why institutions of higher learning must concern themselves with suitably chosen areas relevant to national development, we will describe two such programmes in the Bombay region: one of these involves a metropolitan university, which is trying to move towards a socially relevant course pattern, which may be expected to create a greater awareness among the students about the Indian social reality, and to equip them not only with knowledge, theoretical tools and skills, but also with attitudes that should in later life help them in analysing, understanding, attacking and hopefully, solving problems having a bearing on national development, rural development in particular; the other involves a national laboratory, which is devoting some of its efforts to evolve new teaching/learning methods and to generate educational material which should help improve science teaching in municipal and rural schools. Finally, we will also discuss some of the problems which arise when institutions of higher learning, or individual academics in them, try to get involved in socially relevant programmes, which are traditionally considered as lying outside the legitimate sphere of activities and interests and concerns of such institutions and this discussion will lead us to a suggestion that if such programmes are to multiply and make an impact, they will have to be institutionalized as legitimate activities of the institution concerned, so that a new ethos may be created in the academic community.

When considering the involvement of institutions of higher learning in problems relevant to national development (rural development in particular), the first question that is still often raised is as to why they should enter this domain at all, when there are other agencies seized with these problems already. One expresses a fear, for example, that anything the university may be able to do here would be of a social service nature, and that it is not only not likely to make an impact, but also likely to be detrimental to the purely intellectual academic pursuits which should be the legitimate pre-occupation of such an institution. In particular, why should a metropolitan university start a programme, or even courses, on Rural Development?

PROMISE VS PERFORMANCE OF SCIENCE AND TECHNOLOGY, IN RELATION TO DEVELOPMENT

To approach an answer to these questions, we have to ask why our country, which boasts of the third-largest stock of scientists and technologists in the world, continues to be underdeveloped and poor. It is not technologically poor any more, as seen from the growth of industries and national research laboratories, but it continues to remain poor in terms of the quality of life of the majority of its people or in terms of its continued dependence on imported technology and aid, and search for foreign collaboration or approbation from abroad. There is a clear mismatch between the urgent challenging problems and tasks of development which abound on the one hand, and the built-up capability to solve them, in terms of R & D Laboratories and educated manpower, in science and technology and other areas, that remains unutilized. There are almost a million unemployed graduates in search of jobs. These include thousands of scientists, technologists and doctors who migrate abroad 'for want of opportunities here'. Trained manpower is one of the most important assets for any country which embarks upon a programme of development. Why then is there an apparent surplus of trained people in a country which is aspiring to develop and to eradicate poverty? Has this anything to do with the slow pace of rural development in the country? In a country where 75–80 per cent of the people live in villages, development must have a very substantial rural dimension. If

our resources were deployed appropriately for rural development, would one still have a surplus of educated manpower? *Or would there even be a shortage?* The number of graduates on the employment register is reported to be around 9 lakhs. This works out to only about 1.5 graduates per village or per thousand population. Is this a large number in relation to the complexity of the problems to be tackled. if the nation were to accord a high priority to rural development? Even within the educational sector, 70 per-cent of the population is illiterate, 50 per cent of children drop out of school after the first or second year of schooling, there are about 200.000 single teacher schools, and most rural high-schools have a difficulty in acquiring and retaining science teachers. Similarly, within the health sector, the death-rate in rural areas is almost twice that in urban areas, and yet there are not supposed to be enough jobs for doctors. Is the surplus of the educated then really a surplus in relation to tasks? Unfortunately, neither the Government nor the unemployed graduates seem to think that the growing educated unemployment and the slow pace of rural development have anything to do with each other.

The national scene is thus fraught with several internal contradictions. While education, science and technology hold out the promise of eradicating illiteracy, poverty and destitution, there is a gap between the promise and the performance. In this connection, one has to remember that education, science and technology are merely tools or instruments of social change and economic advancement. They can lead to the desired results only to the extent that there is a planned effort to use them for this purpose. There has to be a social commitment and a political will to define and carry out the operational implications of the professed socio-economic goals, making optimal use of the national resources, including the human resources. Such a strategy would include a far greater emphasis on the Minimum Needs Programme, reservation for labour-intensive or appropriate technologies in identified sectors, emphasis on self-reliance, and a redeployment of resources as between the rural and the urban sectors. In the absence of such an integrated approach, integrating science and technology planning with socio-economic objectives and planning, and both these with manpower planning and

deployment, one cannot expect an optimum utilization of our human resources, with the result that even highly trained men and women tend to be considered a liability rather than an asset.

On the other hand, in the kind of educational system that we have, largely continuing unaltered from the colonial era, a young person is given largely a bookish education that is divorced from the social reality, and no attempt is made to equip the young graduate or post-graduate with knowledge, skills and *attitudes* that would enable him to understand and face the problems of development, not to speak of taking an initiative in trying to find a solution to some of them himself. Moreover, the educational system perpetuates the myth that the knowledge sector is neutral. It emphasizes, explicitly or implicitly, the self rather than the community and competition rather than team-work for common good. The educated individual, therefore, tends to accept inequality and inequity, poverty and destitution, and the gap between urban and rural amenities as an inevitable part of life, to take an apathetic or helpless attitude vis-a-vis problems of development, social change and social justice, and in particular to treat national problems as somebody else's problems, unmindful of the fact that as someone who has had the privilege of higher education in a country in which 70 per cent of the population is still illiterate and 60–70 per cent of the people continue to live below the poverty line, there are some societal expectations from him. The research worker also tends to look for communion with the international scientific community, and to occupy himself with an academic type of research rather than with problems which have a bearing on national development.

The yawning gap between the promise and fulfilment of science and technology and development thus presents a human as well as an intellectual challenge to scientists (natural and social), and other members of the academic community. As intellectually privileged members of the society, they have to analyse the contradictions of the system, undertake field-studies and action-research, and thus point the way towards the solution of the socio-technical problems of development. In doing so, they would also contribute to the inculcation of the right attitudes among their students vis-a-vis their responsibilities in the development process.

LINKING EDUCATION AND RESEARCH WITH NATIONAL DEVELOPMENT

During the pre-independence era, many of our national leaders of social and political movements had realized the importance of establishing links between national reconstruction and education. This led some of them, e.g., Gokhale, Lajpat Rai, Tilak, Malaviya and Gandhi, to name a few, to establish educational institutions with the explicit aim of providing 'national education'. Gandhiji even aimed at creating a cadre of workers, who on the one hand would be willing to work in the villages and on the other hand be contributing to the freedom movement. With regard to the Gujarat Vidyapeeth, Gandhiji said soon after its establishment: "I pray that this college may be accepted of God as one of the potent instruments with which we shall win our independence".

This attitude with regard to the role of educational institutions in national development, by and large disappeared in the post-independence era. There have been some educational institutions like Gujarat Vidyapeeth, Lok Bharati and Gandhigram Rural Institute which have taken an active interest in rural development, and tried to integrate social service and rural extension activities with their educational and research programmes. There have also been the Rural Institutes set up by the Government of India during the fifties — an experiment which was, however, unfortunately never accepted fully by the rest of the educational system and therefore failed[1], barring the notable exceptions of Lok Bharati and Gandhigram Rural Institute. The recent recognition of the Gandhigram Rural Institute as a 'Deemed University', however, signifies the importance the academic world is now willing to attach to programmes integrating education and research with rural extension and development.

The question one can ask is whether such examples can be multiplied, with appropriate changes, in the context of the present challenges of national development, rural development in particular. It appears to me that if this is to happen on a substantial enough scale to make an impact, *some of the prestigious institutions will have to take a lead,* by accepting rural development activities — field work, course-work and training programmes, action-

research, development of appropriate or alternative technologies[2] etc. — as part of their legitimate activities.

More than ten years have elapsed since the Education Commission published its Report under the title 'Education and National Development'. The report emphasized the role of education as an instrument of social change. Yet even now, education and development continue to be considered as two separate sectors, having little or no overlap with each other. In the meantime, a vast infrastructure has been built up since independence — consisting of national laboratories, universities and the Indian Institutes of Technology (IITs), colleges, schools, and the trained manpower that flows from them. This infrastructure must be harnessed for national development. The nation now spends about Rs. 2,000 crores (1 crore = 10 millions) annually on the formal educational system, and an additional amount of about Rs. 300 crores per year on the national laboratories. Is it too much to expect that these institutions, especially colleges, universities and national laboratories, devote at least a part of their energies and efforts to *some* problems having a direct bearing on national development? The Education Minister expressed the hope recently that "the stage has now been set for a big effort to build linkages between Education and National Development"[3]. The question is: how?

The efforts which the Council of Scientific and Industrial Research (CSIR) has recently undertaken through its Karimnagar Project, or the Indian Council of Agricultural Research (ICAR) through its Integrated Rural Development Programme, are to be seen in this context — as efforts of large national research laboratories to break away from their traditional pre-occupations, and not only to contribute directly to development, but in doing so, *to create a new value system among their scientists.* If these programmes are carried out in the right spirit, and generate the desired momentum, they could help transform the rural scene, as well as inject a new vigour into scientific research in the country.

With regard to the universities also, it has been increasingly realized in recent years that the present policy of confining education

within the walls of a college of university is undesirable, and that the whole community and the social environment should become the learning place. As Dr. Sethna said in his recent address at the Special Convocation of the University of Bombay, "Such an enhancement of social activism seems essential if the University is to become a tool of social change"[4]. Today, unfortunately, the higher education system, by and large, keeps itself aloof from society. One may even say it is largely alienated from the society it is supposed to serve.

This weakness of our educational system was sought to be removed by our educational planners, when among the four main thrust directions of the educational policy during the fifth plan period, they identified one as "involvement of the academic community, including students, in the task of social and economic development"[5]. Also, at the 1972 meeting of the Central Advisory Board of Education (CABE), the Minister for Education emphasized that "our educational system needs largescale reconstruction, almost a revolution", and expressed the hope that the academic community would "create a wave of reforms within the educational system which will, sooner rather than later, radiate to all other sectors of society"[6]. The Education Commission had also expressed a similar hope in the mid-sixties, but one has unfortunately seen very little action so far.

There is a wide gulf which separates precept and practice in education — as in other socio-economic spheres — in our country. Action plans often lag very considerably behind radical slogans. The blame for this cannot, however, be laid entirely on the planners and the political and administrative decision-makers. Political decisions, with regard to reforms which are highly innovative or radical in character, are usually not taken in the absence of a climate which is approximately ready for them, especially if they are likely to affect the vested interests. Therefore, the role and responsibility of academics and educational institutions in promoting the creation of the necessary climate cannot be underestimated. Unfortunately, they also often serve to promote the maintenance of the status quo — in education as in other spheres. In this situation, at least some universities, especially some of the prestigious universities, have to take courage and lead the way.

Universities cannot become an instrument of social change unless they are involved with society through a participation of the students and faculty in extension action and action-research — a depth-analysis which itself leads to further meaningful action for social change. And if the social change is to be produced in a largely rural country, some of the university involvement has to be in rural areas. In our society, in which higher education is the privilege of a very small fraction of the population, where development is largely from the top, and where the educated elite have the responsibility of leading, on the path to development, it is necessary that the would-be graduates should have personal first-hand experience of at least some aspects of the multi-dimensional problem of rural underdevelopment, as also methods for the analysis of the underlying causes of poverty, hunger, malnutrition, insanitation, illiteracy and superstition, apathy, helplessness and dependence, and the deadening custom of tradition. The young in the universities have to be sensitised to the rural condition and made to think about the possible contribution that they could make in their later life to national development, rural development in particular. *Education is, not only acquiring knowledge and learning skills, but it also includes an overall training of the mind, including an inculcation of social consciousness and a certain set of values and attitudes.* The university must prepare the student for the role that he may be expected to play in building the new society — as teacher or educator, planner or administrator, legislator or officer in one of the agencies dealing with development, or just an intelligent citizen.

One has to look at the various courses offered to the students from this point of view, and not merely from the point of view of the information content in any particular discipline. From this point of view, no harm will be done if, while retaining a certain hard core of the disciplinary subjects, some of the remaining conventional papers are dropped in order to make room for courses relating to rural development, which could contribute to enriching the personality of the young student's mind and preparing him for his expected role in national development. But it requires academic courage to acknowledge this and make room for new types of courses.

Finally, universities are expected to provide intellectual leadership to the society, especially in relation to critical problem areas, and not merely to teach and conduct academic research. They must therefore study problems of development, rural development in particular, and moreover, as non-governmental concentrations of academic expertise, they should also make an impartial depth-analysis of various ongoing experiments, so as to help generate new models for harnessing our education, science and technology infrastructure for national development, emphasizing the importance of any structural changes in society, that may be required. As stated earlier, this also demands that they cannot remain isolated from society, but must evolve new processes of learning through participatory action, making some kind of development activity itself a vehicle of learning.

The new course structure including courses on Rural Development, that a traditional but prestigious university like that at Bombay has now decided to introduce, has to be viewed in this context. It should start the process of bridging the gap between academic pursuits and societal problems and of bringing greater relevance into educational and research programmes. It will take the university (at least the students and teachers involved in the rural-based field work) to the people, and it is the kind of reform which has the potentiality of making the community itself the laboratory for education, thus enabling the university to start assuming a new role in the society.

EVOLUTION OF A RURAL DEVELOPMENT COURSE PROGRAMME AT THE UNIVERSITY OF BOMBAY

The University of Bombay has recently decided to introduce a five paper course on Rural Development (representing about 25 per cent of the total number of papers in the new 3-year degree programme), which can be taken by an undergraduate student in the Arts, Science or Commerce faculty, as a set of optional papers in lieu of some of the usual discipline-based papers.

As mentioned earlier, educational institutions like Gujarat Vidyapeeth, Lok Bharati, Gandhigram Rural Institute, etc. have

been taking an active interest in rural development, and have integrated social service and extension activities with their educational and research programmes. It is, however, the first time that a prestigious but traditional metropolitan university like that at Bombay has taken an interest in programmes of rural development. It is therefore a pioneering decision, not only from the point of view of giving academic recognition to an important area like Rural Development in the liberal education programme of a university, but also from the point of view of the character of the contemplated course, which will cut across the traditional boundaries of Arts, Science and Commerce, and will incorporate a substantial component of field work ('experiential learning'). The programme deserves serious attention also from the point of view of the fact that this is probably the first effort in a traditional university to organize undergraduate courses around a problem area, bringing different disciplines to bear upon it. If it succeeds, it could provide pointers for the introduction of other interdisciplinary courses at the undergraduate and post-graduate levels.

It may be of some interest to study the genesis of the new course programme. The first phase of interest in rural development at the university began several years ago, with the introduction of the National Service Scheme (NSS). Under the NSS, students started making brief trips to villages, getting exposed to the village situation, and participating in activities such as well-digging, road-making, etc. Such activities under the NSS have been going on in all our universities, and both academics and administrators have often expressed dissatisfaction with the gap between the potentialities of the NSS and its achievement. Some of the Bombay students, however, instead of merely expressing their dissatisfaction with the limited scope of the projects undertaken under the NSS, as also with the university education which, they thought, was divorced from the realities of Indian life, took an initiative in formulating some new projects which would involve the university more deeply in rural development. Specifically, in 1973–74, two young graduates from Bombay University proposed for the consideration of the university authorities, and the Central and State Governments, two projects intended to mobilise the university youth in the cause of educational reform and socio-economic

change in rural areas. Both projects — the National Graduate Scheme (NGS) and the Land University Project (LUP) — were accepted by the State Government and the Bombay University as special NSS programmes, beginning with the academic year 1973–74, and the Ministry of Education, Government of India, sanctioned funds on the NSS pattern to the University, for implementing the projects. It is significant to note that the initiative for both these projects came from students, and that the authorities concerned (the University, the State Government and the Central Government) also found it possible to respond quickly. In fact, the Chancellor, the late Nawab Ali Yavar Jung, himself guided many of the preliminary meetings.

In our country, there are many who criticize the short-comings of government-sponsored programmes, but few who translate their dissatisfaction into constructive suggestions and follow them up. In this case, these students did it, and fortunately found that the alternative projects suggested by them, which would give a new dimension both to the University and to NSS, were accepted, by the authorities concerned, as experimental projects.

I will not describe these two experimental projects in any detail, since these are to be considered as probing attempts, which created the background for the new courses which are now contemplated by the university. For our purpose, it suffices to note that both projects involved an extended stay by students at a suitably chosen rural location — a four-month camp in the case of the LUP, and a whole year in the case of NGS — and thus were an attempt to introduce a new type of learning process, learning with a certain emphasis on participatory action and discussions.

The NGS involved the stay in rural areas for a whole year, of about 20 volunteers, all graduates, drawn from a spectrum of disciplines. They were paid a stipend of Rs. 200 per month for their maintenance. They did not work for any degree. However, one of the principal aims of the NGS experiment was to pave the way towards making field work an organic part of the regular undergraduate educational programme and thereby bring univer-

sity education close to social reality. An idea of the field projects explored by NGS volunteers may be obtained from the following list: demonstration plots for a new variety of wheat, or for dry-farming; collection of information regarding a proposed dairy development project; check-up of village land-records; helping villagers to obtain finance from banks; running a night-school; setting up a *balwadi*; social education (nutrition, health, dental care, sanitation, population, pollution, deforestation and reforestation, etc.); running village libraries; soil conservation; formation of *Tarun Vikas Sena* and organizing social activities through it, etc. Their experience also served to show that such student volunteers could act as catalysts, helping to remove the communication gap between the common man and the Government agencies and officials with their development schemes, so that the benefits of various government schemes meant for the disadvantaged sections of society may actually reach them.

What was the effect of the one-year programme on the NGS volunteers? The volunteers were able to acquire a good deal of knowledge regarding how the Government machinery works at the grass-roots level, and how various schemes implemented, on paper, for economic benefits to the underprivileged sector often remain by and large unknown to the supposed beneficiary. They met and contacted all sorts of people from the Managing Director of the Agricultural Finance Corporation Ltd., to the humblest half-starved *Adivasi* (backward class) farmer, in between including the *Zilla Parishad* (District Office) people, the Block Development Officers (BDOs), the Extension Officers, the Bank Managers and Agents etc. They gained a new perspective as a result of closely observing the Government planning effort on the one hand and staying amidst the beneficiaries of the effort on the other. Noticing the communication gap, they tried to take an initiative to bridge it, and this exercise of initiative has itself been a valuable gain educationally. They came to know that development is much more than an exercise on paper, that it is a human endeavour in which one has to work with the people and soil one's hands.

The report of an evaluation committee in 1974 refers to "the marked change that had come about in their outlook". It goes

on to add, "they had gained self-confidence and a sense of commitment for the objectives of the Project. It could be said that exposure to the realities of rural life such as the stifling hold of the vested interests over the people and community resources, and the prevailing sense of helplessness among the rural folk, made the volunteers lose their innocence and made them conscious about the need for social action".

In the meantime, other experimental efforts had been going on at the University, also under the auspices of the NSS, aimed at linking subject syllabi with the NSS, and converting the NSS programme for the undergraduate students from a mere ad hoc set of welfare activities into an ongoing development project[7]. These led the University to introduce in June 1976, a 'Concurrent Study Service Project' (CSSP), under which a student was allowed the option of taking a paper in 'Environmental Chemistry' or 'Environmental Biology' or 'Environmental Physics' and associated project work carried out in a rural setting (thus utilizing his knowledge in some endeavours of interest from the point of view of rural development), in lieu of a part of the conventional theory papers and practicals. A batch of fifteen senior B.Sc. students in Chemistry availed itself of this option and these students completed their field-based project work during three months of stay at the CSSP Centre at Village Aswali[8], and their experience and response has also been quite encouraging.

About six months ago, the University started a process of having a fresh look at the objectives and structure of courses at the + 3 level in the context of the '10+2+3' scheme. It recognized that the introduction of the 10+2+3 scheme provided a unique opportunity for changing the character of the undergraduate courses[9], which had remained practically unchanged from the pre-independence era, and decided to depart quite considerably from the customary pattern. It has now introduced certain new components in the course programme of an undergraduate student, which are designed on the one hand to increase the awareness of the student about the social, economic and science-technological framework in which he will have to function as a citizen, and on the other hand to bridge the gap between the 'World

of Study' and the 'World of Work'. For this purpose, every undergraduate student will now be expected to take four one-semester courses in (1) Social and Economic Life in India, (2) History of Contemporary World Civilization, with special emphasis on Asia and Africa, (3) Scientific Method, and (4) Science, Technology and Development. These courses, called Foundation Courses, will account for roughly ten per cent of the total number of papers to be offered by the student in a 3-year curriculum. Every student will also be expected to choose two courses out of a large number listed under the 'Applied Component' (again representing about 10 to 12 per cent of the total number of papers). The 'Applied Component' includes such subjects as Social Welfare and Functional Literacy, Environmental Studies, Population Studies, Farm Management, Community Development, Co-operative Management, Developmental Administration, Rural Industrialization, Rural Banking, Soil Science, Electronic Instrumentation, Agrochemicals, Waste Recycling, Food Preservation and Post-harvest Technology, etc. The remaining 75–80 per cent of the course programme will continue to be discipline-based. It will be noticed that while disciplinary studies continue to form the core (75–80 per cent) of the course programme, in the new pattern they will be pursued within a broader framework provided by the Foundation Courses on the one hand, and the Applied Component on the other.

Introduction of these additional components, some of which cut across the traditional faculty boundaries, has also created a climate for introducing other novel course combinations, e.g., an Arts student will now be allowed to take a five-paper course in Commerce or Law or Area Studies, in lieu of some of the conventional papers in the Arts Faculty. Further, what is important from the point of view of the present discussion, a student in any of the faculties, can take a five-paper course in Rural Development, *as a part of the core programme*, in lieu of some of the customary discipline-based courses which he might have taken otherwise. Thus a student can major in Economics and Rural Development, or Sociology and Rural Development, or Chemistry and Rural Development, etc. The University is also considering the introduction of a post-graduate course in Rural Development. It is

significant that these courses on Rural Development are not mere theoretical courses, but that they envisage a substantial component of field work (action-research in the case of the post-graduate courses) involving several months of stay by the students in a rural centre. This implies not only a new approach to the organization of the courses, to the teaching-learning process, but also to the assessment of students.

It may be remarked, from the point of view of later discussions, that a radical departure from the conventional approach to the organization of courses can by and large be taken in the first instance, only by universities which have a standing, and a self-confidence which goes with it. They also call for a leadership and commitment at the highest level, and an enlightened academic community. A similar course pattern (Foundation Courses, Core Courses and Applied Component) has now been adopted in principle by the Madras University also, and some other universities are likely to move in this direction. It is however to the credit of a relatively small and new university, *viz.*, South Gujarat University, that it took the first step in this direction earlier last year. The first batch of students following this pattern of courses will join the Universities of South Gujarat and Madras in 1978 and 1980 respectively. The Bombay University will be the first University where the first batch of students will start on this new course pattern in June 1977.

It may be worthwhile to discuss briefly some of the spin-offs one may expect from this field-based course programme on Rural Development, in due course:

(*a*) Our curricula and text-books in the Social Sciences have long been criticized for not reflecting our social reality; and the curricula in Technology for not reflecting the technological needs of the rural community, so that Appropriate Technology tends to remain only a cliche. The proposed course, with its substantial component of field action, should help the University to develop and generate new educational material for use at the under-graduate and the post-graduate levels. The field action will also

throw up suggestions for new research projects having a bearing on the solution of some of the real-life problems of the society. In this way, one would expect the feedback from the field-experience to make both the courses and research programmes more sensitive to social needs.

The programme should also help identify problems with scientific and technological (S and T) content which need investigation, and thereby generate a programme on Appropriate Technology. The University may have to set up a Technology Resources Pool for this purpose. This could be a part of the Inter-disciplinary Centre which the University has already set up, to provide the base from which the Rural Development courses and action-research projects will be co-ordinated, monitored, and analysed from the point of view of the experience gained, some of which may be transferable to the disciplinary courses also.

(*b*) It has often been suggested that one-year of National Social Service, preferably in rural areas, should be made a compulsory prerequisite for a degree. The proposed programme of the University may give us some concrete ideas about how to do it on a large scale, involving various local agencies effectively, so that the student's stay for a year in a village may be not only an enriching experience for him, but also useful for the village community. It may also tell us over a period of time, how to draw resources for such a programme from other sectors of the society, so that the cost for the educational sector may be minimized. After all, the students undergoing this programme could contribute useful educated manpower for some of the ongoing development projects in the chosen area, on which the society anyway incurs expenditure. This is important from the point of view of evolving a strategy for expansion of the programme. The programme should also enable the University to generate alternative models for making the NSS an integral part of the curriculum (CSSP has already provided one approach).

(*c*) The programme may also help generate new ideas about vocationalisation at the +2 stage. Given the fact that 80 per cent of the population lives in rural areas, if right to work is to be guaranteed to every citizen, jobs will have to be created in the rural areas through massive programmes of rural development, and one of the things that the University, faculty and students, could search for, would be labour-intensive production processes which could be fruitfully located in the rural areas and in terms of these production processes, they could try to define useful programmes of vocationalization at the +2 stage, and work-experience at the lower level.

(*d*) One of the tasks of the University is to develop conceptual frames and models in the social sciences and in the application of science and technology to development, so as to enable us to get out of our dependence on models from the industrialized North. The University's active involvement with rural development should enable it to develop such conceptual frames and models of alternatives to development. This is one more way whereby university education and research could become more relevant.

(*e*) One of the weaknesses of the present development programmes, that was emphasized at a recent National Seminar on Education and Rural Development held at Delhi in December 1976, was the following: There is a disparity between the absorptive capacity of the rural population, their limited ability to make use of the various facilities available, and a whole set of institutions — banks, educational institutions, land-laws and other laws, primary health centres etc. — which are supposed to, but do not, reach down to the village poor who are the supposed beneficiaries. It has been said that while there have been many efforts to improve the delivery line, there have not been adequate efforts to prepare the recepients to derive benefits from the various schemes, and that those at the receiving end do not know enough about the various facilities and programmes offered by the Government.

This is a typical defect of planning from the top, and to the extent that such a situation exists, not only does the vulnerable class of people miss the benefits, but the Government also does not get meaningful feed-back which could help adapt the delivery lines to the needs of the intended beneficiaries. The experience of the NGS suggests that the field programmes under the University should enable the University field group not only to get an understanding of how the Government machinery (including banks and other service agencies) works at the grass-roots level, but also to identify the operational aspects of the mismatch mentioned above. Very often it seems to be a question of lack of communication rather than apathy, and the university students could act as a catalyst, not only telling the rural people about the various facilities and programmes offered by the Government from which they could benefit, but also providing valuable feedback to the Government agencies about the operational deficiencies in official programmes that they notice.

(*f*) Going further, on the basis of the field experience, the University may in due course be able to assist in organizing suitable orientation and training (including motivational training) programmes for officers of banks and other Government agencies involved in developmental work. At the same time, through its involvement as a catalytic agent, it may also be able to create local leadership and cadres in the rural areas, who in due course may be able to deal effectively with the Government agencies themselves, without the assistance of the University youth.

(*g*) At a meeting of the Indian National Development Council, held on December 7, 1973, to consider the Draft Fifth Five Year Plan, the Prime Minister had remarked: "Our main failure in development has been because we have not been able to mobilise the rural community". Could the involvement of the University youth, through the kind of field-based programmes we have discussed, help devise a method for mobilising the rural community, so that

the long-desired process of Planning and Building from Below, may at last start? Is it possible to expect the intellectuals to emerge as an active social force, through their participation in such development-cum-education projects? Will they be able to promote the growth of local self-reliant leadership and cadres? This is indeed a crucial problem, and even if the academic community can point to a path, that will be an advance.

(*h*) There exist isolated instances of high quality programmes for rural development under the leadership of dedicated individuals, e.g., programmes at Gandhigram, Kosbad, Vedchhi etc. The experience of such programmes shows that what limits their expansion is not money, but rather the availability of dedicated workers who would spread the effort in a sustained fashion. Some of them are continually faced with a manpower shortage. One may hope that through the programme launched by the University of Bombay and similar programmes which may be started by other universities, a climate in favour of increased participation in rural development efforts will be created, and even if only a fraction of the students undergoing this programme decide to dedicate themselves to rural development, a cadre necessary for strengthening existing centres and building up new centres of rural development will arise. The cadre would consist not only of graduates of the university but also of village youth with whom they have interacted.

One may suggest, both from the point of view of minimising organizational problems for a university as well as infrastructure expenditure, and from the point of view of helping identified, good on-going rural development programmes with much needed manpower support, that the field-programme of the students participating in the new courses may be organized largely in collaboration with existing rural development organizations. The experience of Kishore Bharati[10], whose innovative programmes in school science are helped considerably by

short-term visits of teachers and research workers from TIFR, Delhi University and other institutions, may be cited in this connection.

THE NEED FOR POLITICAL DECISIONS

There has been considerable discussion during the last two years — e.g. under the auspices of the Science Congress, and at Seminars organized by COSTED and other bodies — emphasizing what science and technology and education could and should do for rural development. One hopes therefore that the climate is now ripe for opening more and more rural-based or rural-oriented courses, at the same time that a University like that at Bombay is starting courses in rural development. If such careers do not open up, there is a danger that the attitudes and aspirations of the youth attending colleges and universities, as of scientists, technologists and educationists, will continue to be shaped by the urban environment and careers, rather than by the challenges of programmes related to rural development, in spite of the University's efforts to change the attitudes through the new courses on rural development. We are already aware of such a situation with regard to doctors.

Creation of rural-oriented careers would, however, very much depend on a *political decision* to use the infrastructures that have already been built, and the manpower that is being trained, for a *massive programme of rural development,* and correspondingly, to shift an increasing quantum of financial investments to the rural sector. This calls for a *political will,* to translate slogans into action programmes. The difficulties in arriving at such a decision can therefore not be under-estimated.

What can be the long-term and sustained incentives for the educated youth to go to villages in *significant numbers* and remain there, engaging themselves in programmes of rural development? This question can be discussed, again, only in the context of a national commitment to rural development. For example, will the much-discussed Integrated Rural Development Programmes get substantial national investments, on a scale which, over a

decade or so, could assure a dynamic revival of the rural communities, and a transformation of the rural environment, in particular creating the basic administrative and social services and cultural infrastructure, and jobs, for want of which the educated (or the uneducated) are today pulled away from the rural areas to the urban areas? Could one envisage a planned programme to create by the end of the Indian Sixth Plan period, at least one Education-Science-Technology-Service Centre in each block (say, one for every 100,000 population), comprising of a Central School, a Rural Hospital (connected with primary health centres and sub-centres on the one hand and a district hospital on the other) and resource units in Agriculture, Science and Technology (*Krishi Kendra, Vigyan Kendra, Udyog Kendra*, which are being promoted by ICAR and CSIR), with quarters for the staff ? Only by creating such Centres as nodal points for the reconstitution of the rural society, will it be possible, on the one hand to encourage urban people to go to rural areas, at least on transfer, and, on the other, to encourage educated rural people to remain there, and thus meet the needs of the rural areas with regard to education, health and science and technology know-how, and overall development.

The initiative of the Bombay University shows that the academic community is now willing to play its role by giving a new orientation to the courses, imparting to the youth knowledge, skills and attitudes that should enable them to contribute to rural development. Related planning and action is now called for at the political and administrative levels. *Could one expect the Sixth Plan to break new grounds in this domain?* Policy and programme objectives in this direction will have to be incorporated in the Sixth Plan, and supported with financial allocations. This in its turn will have further implications for restructuring of our educational pattern, from the school level to the university level and in traditional universities as well as technological institutions and institutes of management.

CHALLENGES AT THE SCHOOL LEVEL

The rural development we are discussing is not merely the development of agriculture or the creation of amenities in rural

areas; but more than that, it means development of the people, their breaking away from the chains of tradition, superstition and resignation, their acquiring an ability to think, discriminate and judge for themselves and imbibing a scientific temper and adopting a forward-looking attitude to the future. Mass education has an important role to play in this regard, even though the time-scale over which its effects are seen may be rather long. True Development cannot remain continuously dependent on a handful of experts brought from the cities.

The creation of a scientific temper in a country where 70 per cent of the population is illiterate, where 50 per cent of the students who enrol in primary schools drop out (or are pushed out) much before they reach Class V, and where a large fraction of the over two million school teachers are not quite scientifically literate (and where even those who have had 'education' in science may retain their belief in miracles), is certainly not easy.

If development is to be not only *for* the people but also *by* the people, it is clear that the universalisation of education and eradication of illiteracy are important and urgent challenges. These will, however, not be discussed here[11]. Even for those children who remain at school, the teaching of science in a vast majority of schools is of such poor quality that schooling fails to create a proper scientific attitude in the mind of the young student. On the other hand, if the right kind of attitude is developed from an early age through the study of science, one may hope for not only an improvement in the climate for the application of science and technology for the improvement of the human conditions, but also for some transfer of this attitude when the student turns to the study of problems in other areas, so that later, as an adult, he may become a more meaningful participant in the development process at the grass-roots level. But how is such a change in the teaching and learning of science to be brought about, especially in a large country like ours, with almost 90 million students studying under more than two and a half million teachers in over half-a-million poorly equipped schools? How could one help the child as well as the teacher to internalize scientific methodology at the same time that we are making science compulsory upto class X, under the 10+2+3 scheme?

There is another problem involved here. Today, while establishing the uniform 10+2+3 pattern, syllabus-framers, text-book writers and examination paper-setters all tend to be drawn from urban institutions, and they have very little idea of conditions in the rural areas. It is then no surprise that the rural student, coming from a slow-paced and technologically limited environment, has a severe handicap in such a system, and that, even if he has the same intrinsic ability as the urban student, he does not fare as well. So either he gives up or, if he (or his family) is ambitious, he migrates to the city, depriving the rural area of its potential leadership — with the result that villages continue to be physically and intellectually under-nourished.

Within a city, the same handicap is felt by the student from a disadvantaged background, studying in the municipal school system.

Thus while science and mathematics, with special emphasis on modern concepts and developments, are at last finding their due place in our school curricula, they largely remain the prerogative of urban traditional learners attending private schools. Very few rural children or municipal school children succeed at the National Science Talent Search (NSTS), or IIT entrance examinations (or even at the entrance examination to the Defence Academy), or become scientists. But talent is certainly spread much more widely in our society. We have to find ways of identifying and fostering it.

Could scientists and their institutions play a role in introducing reforms in the teaching of science at the school level, and in producing educational material for students and teachers, especially keeping the vast majority of disadvantaged municipal and rural school children and teachers in mind? How can we allow over two million school teachers to remain more-or-less illiterate in science when we boast of the third largest scientific and technological manpower in the world? Could the latter not assume a teacher-training role vis-a-vis the former, part of the time?

HOMI BHABHA CENTRE FOR SCIENCE EDUCATION (HBCSE) AT TATA INSTITUTE OF FUNDAMENTAL RESEARCH, BOMBAY

A small group of scientists at the T.I.F.R. has been involved in experimenting with teaching methodology, preparation of educational materials, and orientation programmes for teachers, in the area of school science, for the last few years. Initially, it started working with a group of 10 municipal schools in Bombay, and organized summer orientation courses for the teachers of the municipal schools, to introduce the teaching of science by the discovery approach at Classes V, VI and VII. In the discovery approach, one encourages the children to learn through experiments, daily experiences and conclusions drawn from them, and tries to transform the role of the teacher from one of an instructor to that of a guide and supervisor, who helps the child to do experiments, observe and think analytically. The summer camps, in which the teachers were exposed to this approach, were followed by monthly meetings with these teachers, at which their difficulties in following the discovery method with their students were discussed and the feedback was utilised for evolving a teaching strategy and preparing books for Classes V, VI and VII. The response was quite encouraging. The teachers, most of whom were Secondary School Certificate Holders (S.S.Cs) and had a very limited, if any, background in science, began performing simple experiments themselves and were able to convey some of the spirit of science to their students.

The programme started in 1970 in collaboration with the Bombay Municipal Corporation and continued as a part-time activity of this small group until 1973. About 70 teachers, 7000 children and 2 inspectors participated in it, and the Municipal Corporation gave permission for the students to be examined separately, in relation to the methods and objectives of the programme. The enthusiastic response of the teachers and students, and the perception of the paucity of indigenous research development and extension work in this sensitive area, led the TIFR to institutionalize this programme in 1974, when the Homi Bhabha Centre for Science Education (HBCSE) was created, with the assistance of the Sir Dorabji Tata Trust.

In June 1975, the HBCSE started a collaborative programme with the Sane Guruji Vidya Prabodhini, a college of education at

Khiroda, a village about 500 kilometres from Bombay. The aim was to identify and understand the problems of science education in rural areas and to search for a solution. The first phase, which will continue until 1978, covers classes I–VII in about ten schools within a radius of 15 kilometres of Khiroda. About 100 school-teachers participate in the project. Evaluation of the teaching methodology employed forms an integral part of the programme.

The specific aims of the project are as follows:

(*a*) To study the role played by the language of communication in concept formation; in particular, to study the effect of the difference between the language of text-books and the spoken language of the rural children, as also of that between the language capability of a given class as represented by the language text-books used in that class, and that required to understand the science text-books for the same class; and to design and try out methods to overcome the language handicap.

(*b*) To develop a teaching methodology which encourages pupils to be active participants in the teaching-learning process

(*c*) To link the class-room science with the day-to-day experience of the pupils, and to integrate the latter with the text materials

(*d*) To develop a meaningful laboratory programme based on the use of inexpensive materials easily available in the area, emphasizing resourcefulness, and relating laboratory experiences with daily life.

(*e*) To develop a method for teacher-training, with a view to training the teachers to effectively use the above teaching methodology — a method that should be capable of large-scale multiplication.

Here in the Khiroda project also, the HBCSE has been working through a two-week orientation course during summer, followed

by monthly meetings of a few days with the teachers, and visits to the schools. There is also a one-week course for the teachers during winter.

The programme with the municipal schools in Bombay has also been resumed recently, now at the level of Class VIII; it will be extended to Classes IX and X in the coming years.

For a discussion of the teaching methodology employed in the project and the manner in which new teaching materials including handbooks for teachers are being developed, as also the manner in which new tools for evaluation specific for the Indian situation are being developed and standardized, I will refer to a recent paper by V. G. Kulkarni[12]. Our experience has been that the students and teachers in the under-privileged school system respond very well if one approaches them with understanding and empathy. Further, if the language difficulty of the first-generation learner is understood sympathetically and a conscious effort made to improve his verbal ability, the new learner is able to progress faster in the class, and the difference between the traditional learner and the new learner can be brought down. Moreover, this can be done through the ordinary run of teachers.

In this context, one may narrate in passing, a conversation which the author had with a high official in the Ministry of Education a few years ago, when he was describing to him the work of the TIFR group with the Bombay municipal schools. "But don't you find that the municipal school children have a low I.Q.?" asked this official, and appeared surprised when I told him that our experience showed that they were quite bright. The officer did not seem to have realized that he was making the serious mistake of assuming that intellectual poverty is a necessary concomitant of material poverty, and that in doing so, he was essentially writing off an overwhelming majority of our population as far as opportunities for a decent education and a decent life are concerned.

What Bloom[13] has to say in a recent book is important in this context. On the basis of a decade of research by himself and his group, Bloom challenges some constructs that have domi-

nated educational thinking in the past, namely, that "there are good learners and there are poor learners" or that "there are fast learners and there are slow learners". He claims that "most students become very similar with regard to learning ability, rate of learning and motivation for further learning — when provided with favourable learning conditions". On the other hand, he also points out that students become very dissimilar with regard to learning ability, rate of learning and motiviation for further learning, if the learning conditions are unfavourable — as is largely the case today. This implies that while there are no human barriers to the learning capabilities of children, environmental factors (at school, at home and in the society) do create barriers.

Before closing this section, I may mention that the TIFR collaboration with the Bombay Municipal Corporation was to some extent responsible for encouraging scientist-teachers of Delhi University to participate in an innovative science-teaching programme at Kishore-Bharati[10] in Madhya Pradesh. Just as the Maharashtra Government has shown considerable interest in the HBCSE programme and has offered to publish the teachers' guides prepared by the HBCSE, the Madhya Pradesh Government also has shown an interest in the Kishore-Bharati programme. India is a vast country, and each region has its own problems, and science teaching methods have to be evolved, teachers trained, and educational material produced, taking the local environment into account. One therefore hopes that groups in universities and national laboratories elsewhere will take an increasing interest in this challenging task of improving the science teaching at schools, and thereby raising the scientific level of the masses. In the meantime, to the extent that the teaching methodology developed by the HBCSE on the basis of the field experience in municipal schools and the rural schools around Khiroda are relevant and appropriate for the needs of the underprivileged sections, efforts are being made to transfer this experience to the NCERT, which now happens to be engaged in the production of new text-books and teachers' guides in the context of the introduction of the 10+2+3 scheme.

SOME BASIC ISSUES[14]

The two examples we have discussed indicate the potentiality

of the contributions that institutions of higher learning could make towards the solution of some of the problems of rural development. One should not however underestimate the serious hurdles to be crossed, if such involvement of the academic community in 'relevant' problem areas, which transcends the normal disciplinary class-room or laboratory-centred pursuits, is to occur on a large enough scale, to make an impact on the national scene. Firstly, one has to realise that involvement in such a programme is not an easy decision for a research scientist or university academic, given his discipline-based training and the overall value-system of academic institutions in which he operates. One often talks about changing the attitude of the villager. What is equally, if not more, important (and difficult) is for the intellectual elite to change his attitude vis-a-vis his role in societal problems. While his training is usually in a single discipline and confined to the precincts of an academic institution, most of the real-life problems of development are interdisciplinary and involve varying degrees of participatory social action, which the academic usually shuns. Further, in the academic community in which he operates, his peers judge him by his research production in his discipline, and his approbation from other scientists and his material advancement are also determined by his continued creativity in that discipline. In fact, his peers may think the better of him even if he continues to produce inconsequential but competent papers[15] rather than if he marshals his intellectual abilities and skills to attack some important socially relevant problem. In the latter case, they may think that he has given up his loyalty to science or that he is becoming a drop-out. The scientist has therefore to overcome a sense of insecurity when he steps out of his ivory tower. The student also is subjected to a conflict between two value systems. What is worse, their institution may also harbour a feeling of insecurity if its scientists start embarking on problems which are not supposed to lie strictly within the institution's mandate. Are they not wasting their time on such social-service type of activities? Would such efforts not alter the character of the institution, and dilute its high academic standards? Would they not make inroads into the already meagre resources available for basic research? Should such efforts not really be somebody else's business? In view of this double problem of insecurity

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of the individual and of the institution — if the process of scientists' participation in 'relevant' activities is to gather momentum, it is important for academic institutions to give up the frequently observed ambivalent stand, and give legitimacy to such 'relevant' endeavours by taking a clear, conscious and deliberate decision to encourage certain carefully selected socially relevant programmes, where the expertise in the institution can be usefully harnessed. Steps like the new courses on Rural Development at the Bombay University, or the creation of the Homi Bhabha Centre for Science Education at the TIFR or the ASTRA at the Indian Institute of Science, Bangalore, or the formulation of the Karimnagar District Development Project by the CSIR, thus represent an important new trend that is most welcome. Once such a decision is taken, and the new programme 'adopted', the institution should of course continue to apply its usual high standards of excellence in judging the performance of the staff engaged on the programme, when considering their professional advancement or when making a periodical review of the programme, or when assessing the performance of the students. In that case, there would not only be no dilution of standards, but the new 'relevant' programmes will even enrich the intellectual atmosphere in the institution. Moreover, the standards of excellence and 'relevance' of the institution will permeate into the other organs of the social system which participate in the execution of these programmes.

With the experience of the above-cited examples in view, I would like to suggest that in order that the scientific community and its research results may be brought to bear on the most urgent problems of society and this be done on a large scale, it would be desirable to evolve a model or a code of conduct for all educational, scientific and technological institutions, which stand for excellence, that a certain identifiable (say 10–20 per cent) and appropriately budgeted component of their education, research and development programmes must be devoted to socially relevant endeavours. Prestigious institutions have to lead the path towards legitimization of developmental work and a change in the value system and recognition pattern of the academic community. In making this suggestion, I am not suggesting that every member

of the institution must devote a certain fraction of his time to a socially relevant endeavour. What is important is that the culture of the institution must accept that some of its members would be participating in such activities as legitimate activities — some on a full-time basis, and a larger number on a part-time basis.

The society may expect a similar commitment from the industrial and business houses also, in the form of a commitment to apprentice training, or adoption of villages or slums or districts for all-round development, etc.

There have been suggestions from time to time that National Social Service should be integrated into the curriculum of a university student, as also that the NSS should be made a pre-requisite for a degree. If this is to happen, apart from the organizational, administrative and financial problems involved, one has also to face the attitudinal problem mentioned above. This again calls for a legitimization of extension work — work for rural development in particular — in a university, so that a university academic may be able to refer proudly to his extension work, in the same way that he may refer to his contributions to teaching or research.

I would therefore like to end these remarks with the suggestion that the Acts of Universities must stipulate that their functions are threefold: namely, Education, Research and Extension. This is already the case with the Agricultural Universities.

FOOTNOTES AND REFERENCES

1. For a discussion, see Anil Bordia, 'Innovation in Indian Higher Education', paper presented at the Seminar on The Problems involved in setting up new types of Higher Education Institutions in Developing Countries and Regions, Paris, October 5–8, 1976.

2. See, for example, Y. Nayudamma and K. D. Sharma, 'Alternative Technologies: A Quest for New Science', in *"Science in the Service of Basic Human Needs'*, Proceedings of a COSTED Seminar, Hyderabad, August 10–13, 1976 (Andhra Pradesh Academy of Sciences, Hyderabad, India).

3. Prof. Nurul Hasan. remarks at the inauguration of a Seminar on Education and Rural Development, Delhi, December. 21, 1976.

4. H. N. Sethna, Address at the Special Convocation of the University of Bombay, September 6, 1974.

5. Draft Fifth Five-Year Plan, **Vol. II**, 8.9, p. 192.

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7. See, for example, G. R. Rane, 'We Link up Education with NSS', mimeographed brochure, NSS Unit, Bombay University, October 1975.

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9. B. M. Udgaonkar. 'Some Thoughts on the Reorganization of the Course Pattern at the +3 Level'
See also, B. M. Udgaonkar, 'Restructuring Education in Science and Technology', invited paper presented at the Seminar on Alternatives in Education, Simla, November 1976, and 'Restructuring Education at +3 Level', Second Report of the Education Committee, Maharashtra Academy of Science, November 1976.

10. P. Ganguli, 'Science Teaching on Rural India — an experiment', *Fulcrum*, January 1976, p. 16.

11. For a discussion of some aspects of this problem, see B. M. Udgaonkar, 'Education in Developing Countries' in *"Science in the Service of Basic Human Needs"*, Proceedings of a COSTED Seminar, Hyderabad, August 10–13, 1976 (Andhra Pradesh Akademi of Sciences, Hyderabad, India).

12. V. G. Kulkarni, "Science Education for the First Generation Learners in Rural Areas", HBCSE, March 1977.

13. B. Bloom, 'Human Characteristics and School Learning', McGraw Hill, 1976.

14. B. M. Udgaonkar, "Research and Basic Human Needs — Closing the Widening Gap", paper presented to the UNESCO

Seminar on Research and Basic Human Needs, Venice, December 11–12, 1975, to be published in *New Quest*, April 1977.

15. I am indebted to my friend Professor Babulal Saraf for the expression "routine-fundamental-research" to describe such activity.

KARIMNAGAR-CSIR'S EXPERIMENT IN INTEGRATED RURAL DEVELOPMENT

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Karimnagar district, one of the backward districts of Andhra Pradesh, has been adopted by the Council of Scientific and Industrial Research (CSIR) in 1972 for changing the face of underdevelopment through the application of science and technology. "The experiment essentially centres around 'Man', the goal being to create competence in him to use his resources for producing wealth and so that he can live in dignity and in harmony with his environment"[1].

The techniques of science and technology are to be coupled with the human and natural resources available, following an integrated approach so as to cover soil-water-crop management, agricultural practices, processing of agricultural products and by-products, public utility services like roads, buildings, structures, public health care and delivery, nutrition, family planning, agro, agro-waste, forest, mineral, and animal-based industries, pollution, effluent and ecological systems and utilisation of waste, formal and non-formal education coupled with work experience, etc.

BRIEF PROFILE OF KARIMNAGAR DISTRICT

1.	Area ..	11,800 sq.km.
2.	Population (1971) ..	1.96 million
3.	Gross value of agricultural output per hectare (1967–68) ..	Rs. 706
4.	Per-capita consumption of electricity ..	34 KWH
5.	Literacy (1971) ..	15.31 per cent
6.	Railways, route length per 100 sq.km. of area (1971) ..	0.89

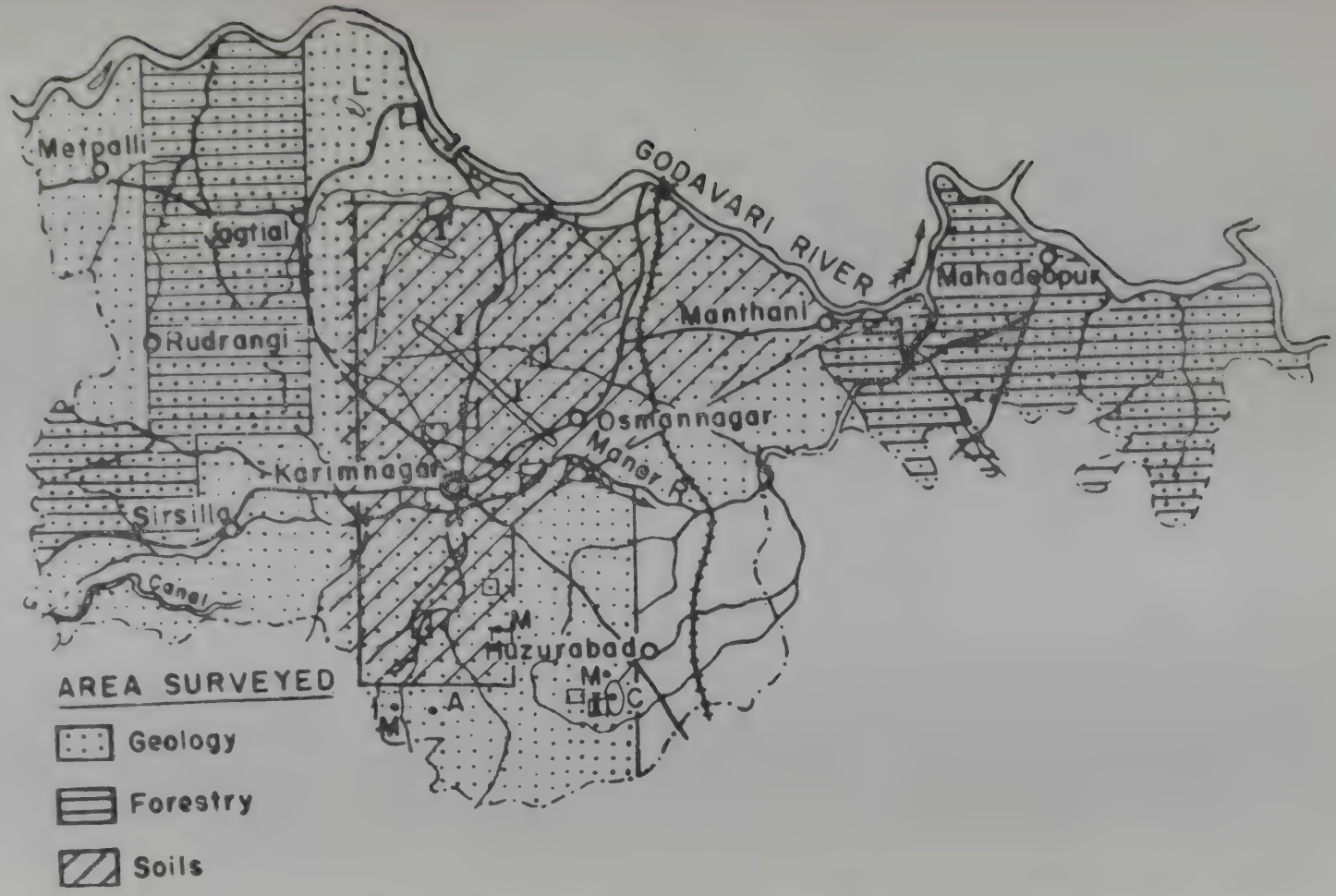

Fig. 1. Karimnagar District - Present status of natural resources surveys using aerial photointerpretation techniques.

7. Length of all-weather roads per 100 sq.km. of area (1972) .. 12.0 km.
8. Per-capita net domestic product (1968–69) .. Rs. 450

FIRST PHASE: (1972-73)

In order to facilitate preparation of a plan of action, the Project has been divided into the following three sectors:

(i) Civil Engineering
(ii) Industries
(iii) Natural Resources

Each of these three sectors was entrusted to one laboratory of the CSIR, which in turn was to associate itself with other concerned laboratories in the respective disciplines and prepare sectoral plans for the Project.

The plan prepared for the Civil Engineering sector covers roads, housing, sanitation, water supply and environmental hazards. The roads plan prepared by the Central Road Research Institute (CRRI) aims at improvement of density of all-weather roads from 12 km to 46 km per 100 sq.km., utilising the local skills, materials and soils. The CERI and Structural Engineering Research Centre (SERC) prepared designs and specifications for houses of families of different economic levels, and public buildings. The National Environmental Engineering Research Institute (NEERI) prepared plans for sanitation, water supply schemes and *Gobar*-gas plants.

The Industries plan prepared by the Regional Research Laboratory, Hyderabad RRL(H) in cooperation with the Central Leather Research Institute (CLRI), Central Food Technological Research Institute (CFTRI), Central Indian Medicinal Plants Organisation (CIMPO), National Chemical Laboratory (NCL), etc., covers the entire spectrum of industries based on raw material availability, dealing with chemicals, oils, pesticides, post-harvest technologies, food, leather, metallurgy and medicinal plants.

The National Geophysical Research Institute (NGRI) prepared a plan for natural resources surveys and the Indian Photo-interpretation Institute (IPI) of the Survey of India carried out

surveys in parts of Karimnagar district, based on aerial photo-interpretation techniques. NGRI utilized the data thus obtained in hydromorphology and geohydrology and carried out groundwater surveys in a large number of villages. The National Aeronautical Laboratory (NAL) conducted wind velocity surveys for location of wind mills at different locations.

In the first phase covering 1972–73 all these three sectoral plans were prepared for execution through different agencies. The guiding factors were that the plans

— fit in with the national goals, programmes and need-based policies
— use indigenous skills and resources
— generate employment for local people
— have a multiplier effect
— produce visual impact
— result in demonstrable improvement in existing technologies and
— contribute towards the welfare of the weaker sections.

While formulating the strategy of development, an attempt has been made to formulate concrete proposals and set them in a proper time-perspective with priority given to schemes which can provide employment and can be executed in a short time. The need for bridging the gap between the sophistication of the scientist's technology and the level of technological capability existing at the district level has also been kept in mind.

The programme suggested follows a broad strategy of development for the district, taking into account also the spatial distribution of the resources. Though a long-term integrated approach was considered desirable in planning the project, the strategy of implementation does not require the implementation of the total plans, but permits the immediate execution of such integral parts of the plan as command priority in the socio-economic framework set for the development of the district.

The draft project report was discussed with the district officers, the *Zilla Parishad,* the Heads of Departments, and multidisciplinary

groups of experts. The project report was then considered and approved by the steering committee at the State level.

SECOND PHASE: (1974-76)

During the second phase, the efforts of CSIR were mainly directed to putting on ground the various schemes envisaged in the three sectoral reports. The work relating to surveys for natural resources through aerial photo-interpretation techniques and limited ground checks were continued. It has been clearly established in the second phase of activity that many of the CSIR technologies envisaged are appropriate to the living conditions of the people and the environment of Karimnagar District. The following are the highlights of the work done:

Civil Engineering Sector-(Public Utility Services) Training Programmes

In order to familiarise the local engineers, supervisors, masons, etc., with the CSIR technology, training programmes have been arranged by CRRI, SERC, and NEERI. This helped in their appreciation of the technology advocated by CSIR, and its faster propagation.

Roads

Detailed investigations were carried out for about 500 km length of different categories of roads. Based on these investigations, designs and specifications were prepared for more effective and economical constructions with the maximised use of locally available material. The roads investigated include:

Name of work	Road length (km)	Estimated cost Rs. millions
(*a*) Feeder roads for the Pochampad Project (World Bank assisted, for irrigation) ..	250	15.0

(*b*) Public Works Department roads (improvement) ..	102	8.0
(*c*) Zilla Parishad and village roads..	100	3.5

Several of these works are being executed by local Government agencies utilizing CSIR technologies. A one km all-weather road connecting the main roads to the *Harijan* colony at Vigyannagar has been constructed by CRRI as a demonstration.

Housing

A colony of 42 dwellings (besides a number of other works) was constructed with the improved techniques of pre-casting, etc., for economically weaker families by way of demonstrating the feasibility of the improved techniques. Fig. 2 shows a view of the *Harijan* Housing Colony at Vigyannagar.

Fig. 2. A view of the Harijan housing colony at Vigyannagar along with the approach road constructed with CSIR technology.

There are a number of housing schemes at hand:

Type of housing	Estimated cost Rs. millions
Housing Colonies ..	6.5
Community buildings in over 50 villages ..	0.3
Buildings for hospitals, schools, health centres, grain-storage bins, bio-gas plants, etc. ..	2.0

Improved low-cost dwellings (for slum dwellers) thatched huts with thatch treated for fire retardation and longer life, are also included.

Public Health Engineering

Eight rural water supply schemes, with the use of improved designs, have been completed at a cost of about Rs. 4 million. An additional four schemes costing Rs. 1.2 million are at hand. Existing water supply schemes in six towns are being remodelled for improvement at a cost of Rs. 0.6 million. Fig. 3 shows an experimental wind-mill erected for lifting water from an open well.

A number of bio-gas plants have been installed. One community bio-gas plant is on the anvil. Three night-soil digesters are being installed in student hostels. Fig. 4 shows a view of the *gobar*-gas plant installed with CSIR know-how at Mulkanoor village.

The town of Karimnagar has been given a scheme for improved solid-waste management. The use of low-cost sanitary latrines is being propagated and promoted through demonstration and social work. Local industries are being assisted in the control and treatment of their effluents. Assistance has been provided for chlorination of well-water in villages. Fig. 5 shows chlorination of well-water at Pachnoor village.

INDUSTRIES SECTOR

Based on needs, potential and feasibility, a programme for industrial development of the district is envisaged, with an invest-

Fig. 3. An experimental wind-mill erected for lifting water from an open well.

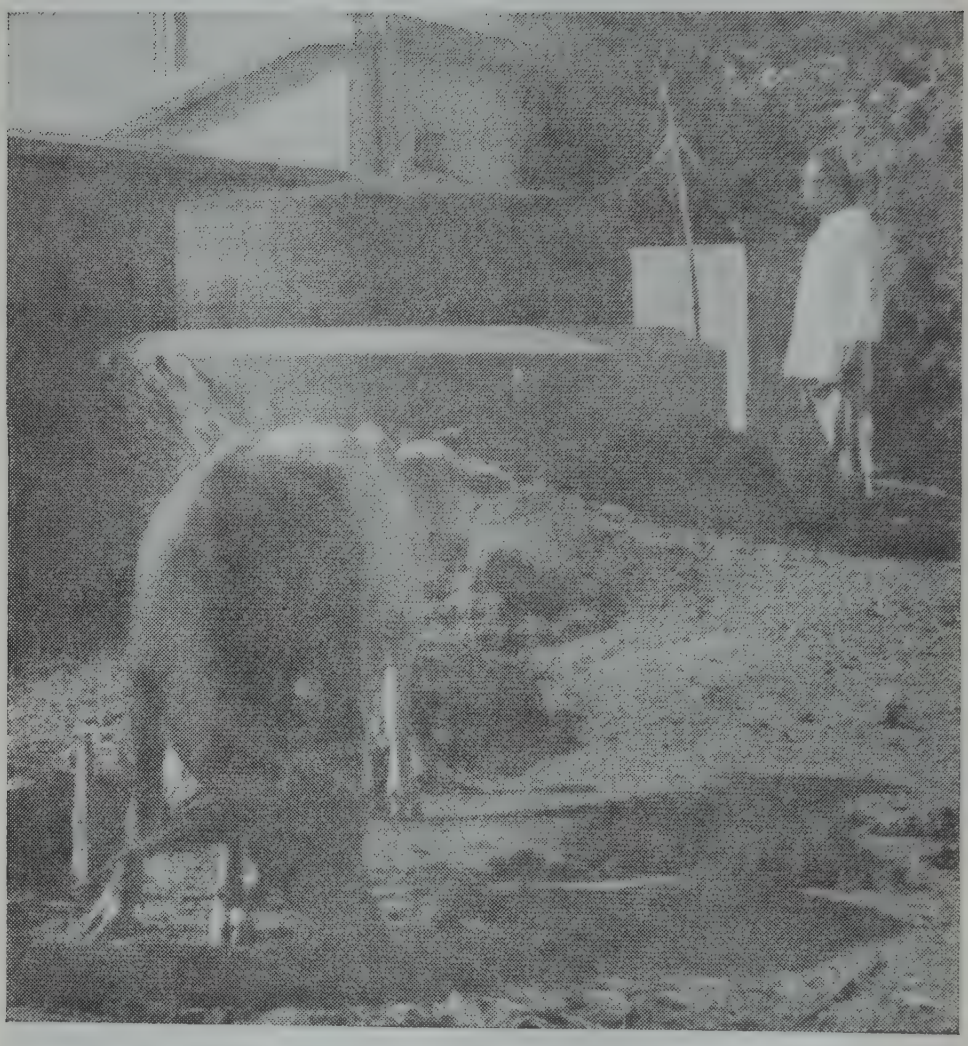

Fig. 4. A view of the gobar-gas Plant installed with CSIR know-how at Mulkanoor village.

Fig. 5. Chlorination of well water, carried out at Pachchnoor village.

ment of Rs. 400 million. However, initially, a programme for 28 industries is being pursued for an outlay of Rs. 56 million with an employment potential of 3600 persons directly and another 10,000 indirectly.

The highlights of the progress made towards demonstration and acceptance of food technologies in the district are:

* Improved technology for rice milling (use of rubber shellers) to increase the yield of head-rice by about 1–2%. Seven of the existing mills have already switched over to this technique.

* Mini-mills have been designed and developed for the production of rice, maize, etc. The prototypes are being installed in the district for full-scale trials.

* Low-cost techniques for pest-proofing of gunny bags to be used for the storage of food grains — A number of local units have already taken to this technique.

* Training classes have been organised and demonstrations held by CLRI in several villages in skin and hide-covering and leather technology.

* An egg-powder plant, with a daily capacity of 1 tonne is being set up near Karimnagar. Satellite poultry farms and a central plant for poultry feed are being established simultaneously.

* A plant is being set up for the manufacture of hand-made speciality paper. The unit will be making certain special grades of paper. A 5-tonne per day machine-made speciality paper plant, based on rice straw, is also being promoted. A straw board unit is being set up at Jagtial.

* Citronella planting has been introduced.

* A number of schemes are in various stages of implementation. These include

— Solvent extraction plant, 100 tonnes per day capacity
— Edible ground-nut flour plant
— Oil milling complex based on minor oil-seeds
— Straw-based paper plant
— Tannery
— Bone mill
— General engineering workshop
— Decorative utility enamel-ware
— sanitary chemicals
— Mini-steel plant

NATURAL RESOURCES SECTOR

The status of the natural resources surveys completed during the second phase is indicated below.

Using air-photo interpetation techniques, work was taken up by the I.P.I. of Survey of India for the preparation of geological, geomorphological, geohydrological, forest and soil maps. The work of surveys and mapping is in advanced stages of completion and an integrated land-use map is being prepared for optimal resources. Some of the salient findings of these surveys are:

* Location of deposits of cement-grade lime-stone to the extent of 150 million tonnes.

* Location of deposits of chalcopyrite and other minerals and rocks. Schemes are under preparation for the promotion of small-scale and cottage industries based on quartz marble and other rocks and minerals available in the District, by the Geology Department of Osmania University through a sponsored scheme.

* Identification of land erosion and remedial measures.

* Location of suitable sources of groundwater for drinking and irrigation. Geophysical surveys have been completed by NGRI in 150 villages with water scarcity and 60 wells have already been successfully drilled. One well drilled

in the basin of a rivulet is yielding 40,000 gallons/hour. Work is now on hand for locating sources of groundwater for drinking and community irrigation for an additional 100 villages.

* Survey and mapping of forests has brought out the need for improved management and exploitation techniques.

* After soil mapping, the soil-water-crop system is now under review.

* Land-use maps are being prepared with suggested land use patterns for long-range planning, by the Geography Department of Osmania University through a sponsored scheme.

* Wind velocity surveys have been carried out and 7 wind mills are being installed for the purpose of lifting water for community irrigation.

THIRD PHASE: (1977-80)

With the experience thus gained and the success achieved in demonstrations and trials, it is now necessary to aim at optimum coordination between human and physical resources, technological inputs and innovations. The plans need to aim at the entire spectrum of human life including childbirth, child care, maternity care, nutrition, health, education, sanitation, improvement of local skills, agriculture, cottage industries and the application of appropriate technologies. It has been recognised that CSIR has certainl imitations in undertaking such a big project especially when it has little or no expertise in the field of agriculture, animal husbandry, health and education. The assistance of ICAR, ICMR, and the State Departments of Agriculture, Health, Education, Industries, etc., is necessary for an integrated approach to development.

Considering all the factors, clusters of villages in seven taluks have been selected in consultation with the District Collector for the concerted approach to integrated development on the lines outlined above. The seven clusters of 60 villages include:

(1) Karimnagar and the surrounding 20 villages
(2) Mulkanoor and the surrounding 5 villages
(3) Sircilla, Vemulawada and the surrounding 9 villages
(4) Jagtial and the surrounding 7 villages
(5) Metapalli, Korutla and the surrounding 5 villages
(6) Ramagundam and Godavari Khani and the surrounding 5 villages
(7) Mahadevpur and the surrounding 9 villages

The planning for agricultural development in the 7 clusters of villages needs to make full use of geological, geomorphological, geohydrological, soil and various other maps. Land management and land reclamation practices need to be demonstrated in areas as indicated by photo-interpretation techniques.

Rural Education (formal and non-formal) is essential for the people in these areas to make them useful citizens, and to engage them in gainful employment and also to create in them a sense of participation in the process of development. The education should be functional and integrated with the employment and developmental activities.

The main factors that will have to be examined while dealing with health issues are problems such as water supply and its storage, nutrition and family welfare and the environment. The impact of poverty on the ill-health and of the ill-health on economic development is only too obvious, and an integrated policy for health has to be evolved for such a backward region as Karimnagar district.

The State Bank of Hyderabad as a lead bank for the district, has prepared a credit plan for Karimnagar district on the basis of a survey conducted by the Bank, evolving a strategy of development suitable for this area. Natural Resources, principal economic activities in agriculture and allied fields, and industries have been taken into account while identifying the schemes for financing by the banks in the district. The integrated CSIR plans including industries have also been taken into account by the State Bank of Hyderabad in the preparation of the credit plan.

The project is increasing its activities and with the launching of the third phase of integrated development in the seven clusters, the multiplier effect produced by implementation of the plan is expected to spread throughout the district. There have been discussions with administrators, social scientists and politicians at various stages of this project. It is necessary now that formal association of these categories of expertise with scientists and technologists is established to move forward in an integrated manner. Much will depend upon the resources to be made available by the government agencies and the scientific, technical and other service personnel to be provided for furthering the project. The Karimnagar experience shows that given the necessary directives and facilities, scientists can come out of their ivory towers and together with administrators, social scientists and politicians, they can contribute their share towards the economic and industrial development of the rural poor.

ACKNOWLEDGEMENTS

The talk on the Karimnagar Project was originally scheduled to have been delivered by Dr. Y. Nayudamma, Director-General, Council of Scientific and Industrial Research (CSIR), who has been the originator and a guiding spirit behind the project ever since CSIR initiated the same in 1972. Due to his pre-occupations abroad he could not be present on the occasion and the responsibility for presenting a brief report on the Karimnagar Project fell on me. As one of the co-directors for the Natural Resources sector, I acknowledge the inspiring guidance which Dr. Nayudamma has been providing in the planning and execution of the Project. I am grateful to Shri Y. S. Murthy and Shri G. H. Rao for collection of valuable data and for helpful discussions.

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PROBLEMS IN THE GENERATION AND DIFFUSION OF APPROPRIATE TECHNOLOGIES: A CONCEPTUAL ANALYSIS

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INTRODUCTION

The mounting storm of literature on appropriate technology has centred either on the criteria for the choice of technology or on the impediments to the diffusion of these technologies. In contrast, little attention has been directed to the problems associated with the *generation* of appropriate technologies. It is mainly this aspect of the subject which will be explored in this paper.

At the outset, however, it should be stressed that the term "appropriate" acquires semantic content only when the question "appropriate to what?" is answered. "Appropriate to a country/region" and "appropriate to the factor proportions of a country/region" are the usual senses in which the term is used. A broader perspective will be adopted here[1]. Appropriateness is judged in relation to the objective of a *development* which is environmentally sustainable over the long run.

This type of development can be described as a process of change primarily directed towards the following objectives:

(*a*) the satisfaction of basic human needs (starting with the needs of the neediest) in order to reduce inequalities between and within countries
(*b*) endogenous self-reliance through social participation and control, and
(*c*) harmony with the environment.

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Appropriate technologies, therefore, will be defined as those technologies (or set of technologies) which advance the primary development objectives listed above.

For a developing country to choose appropriate technologies it has to evaluate the appropriateness of various technologies by putting them through a screening or selection procedure. In doing so, it has to reckon with technologies coming from various sources. Firstly, there are the technologies which are (or have to be) imported from other countries: either technologies from the developed countries, which for want of a better term will be referred to as 'western' technologies, or technologies from other developing countries, which invariably turn out to be "blurred xerox copies" of western technologies. Secondly, there are the technologies which have been (or have to be) generated within the country itself. There are two types of such internally generated technologies: (1) 'naturalized' technologies which are based on the import, imitation and adaptation of western technologies, and (2) 'alternative' technologies which are either specifically designed *ab initio* for appropriateness, or evolved from traditional technologies by a transformation based on inputs of the rich heritage of scientific and engineering knowledge, research, materials or techniques.

The whole selection process becomes meaningful only when there is a wide enough choice of technologies. In most situations, however, western technologies and their derivatives, *viz.*, naturalized technologies, are the only ones available (apart from traditional technologies in their pristine form) even though it is precisely the tendencies of some of these technologies which have led to the plea for appropriateness. On the other hand, very few alternative technologies have been developed with the thoroughness, rigour, reliability and turn-key character of the technologies of the developed countries. Besides, they are rarely available "off-the-shelf." Hence, for alternative technologies to become candidates in the arena of choice, their generation is an essential pre-condition. Herein lies the importance of the generation of appropriate technologies.

A GENERALIZED SCHEME FOR THE GENERATION OF TECHNOLOGY

A fundamental assumption underlying this paper is that the pattern of technology is shaped by, and in turn shapes, the society in which this technology is generated and sustained. More specifically, technology responds to social wants, which are in turn modified and transformed by technology through a causal chain, or rather, causal spiral, which can be schematically represented as shown in Fig. 1.

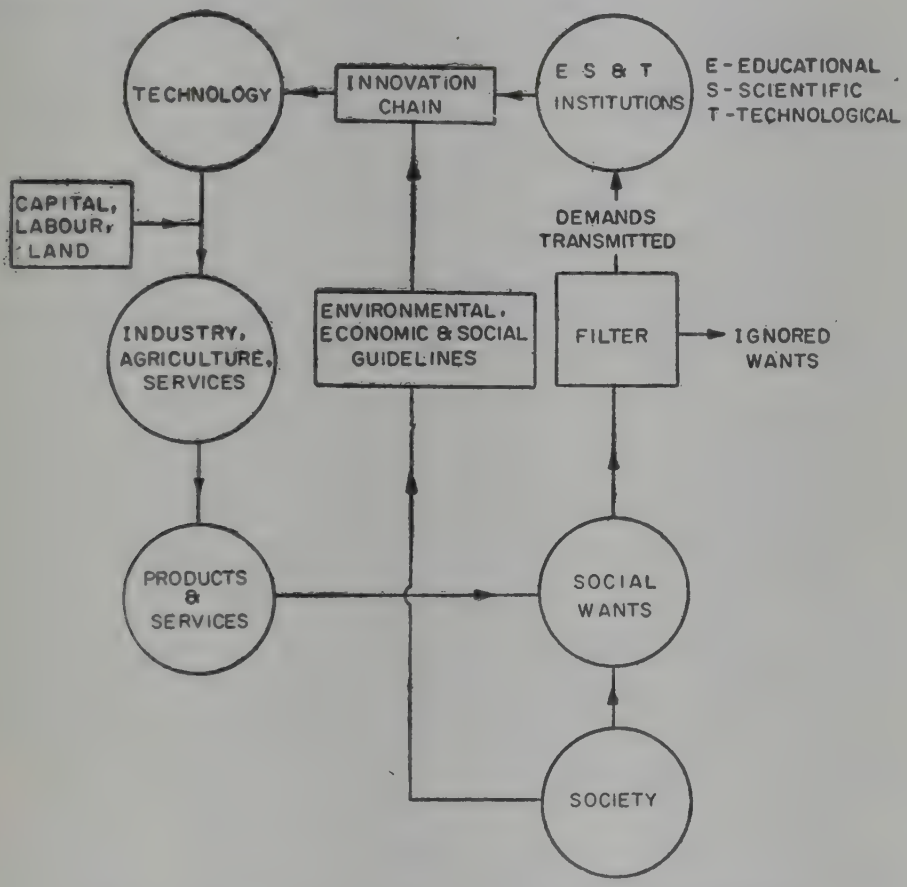

Fig. 1. Generalized scheme for the generation of technology.

Some features about the conceptual scheme represented by Fig. 1 are mentioned below.

(1) All social wants are not necessarily responded to by the institutions responsible for the generation of technology, *viz.*,

the educational, scientific and technological institutions. There is a process of filtering these wants, so that only a certain fraction of them are transmitted as demands upon technological capability, and the remaining fraction is bypassed by these institutions. In other words, there are ignored wants which institutions do not seek to satisfy by research and development.

This filtering process is usually operated by decision-makers in the bodies which control the research and development institutions, *i.e.*, by decision-makers in government, in the science and technology organs of government and corporations, and in the institutions themselves. These decision-makers are influenced by various forces — political, social and economic.

In untempered market economies, only those wants which can be backed up by purchasing power become articulated as demands upon the research and development institutions, and the remaining wants are bypassed, however much they may correspond to the basic minimum needs of underprivileged people.

(2) The generation of technology involves the so-called innovation chain which is the sequence of steps by which an idea or concept is converted into a product or process. This sequence of steps varies with the circumstances, but can often be schematically represented thus:

> Formulation of research and development objective ⟶ Idea ⟶ Research and development ⟶ Pilot-plant trial ⟶ Market survey ⟶ Scale-up ⟶ Production/product engineering ⟶ Plant fabrication ⟶ Product or process.

(3) It is essential to note that socio-economic constraints and environmental considerations (if any) enter the process in an incipient form even at the stage of formulation of the research objective, and then loom over the chain at several stages. These constraints are in the form of preferences or guidelines — or paradigms, to use the currently fashionable word — for example, "Facilitate centralized, mass production!" "Save labour!" "Automate as much as possible!" "Don't worry as much about capital and energy (in the days before the energy crisis) as about pro-

ductivity and growth!" "Polluting effluents or emissions are externalities!", etc. Thus, every technology that emerges from the innovation chain already has congealed into it the socio-economic objectives and environmental considerations which decision-makers introduced into the process of generating that technology.

(4) The technology that emerges from the innovation chain will become an input, along with land, labour and capital, to establish an industry or agriculture or a service only if the aforesaid socio-economic and environmental constraints are satisfied. Thus, it is not only the technical efficiency of the technology, but also its consistency with the socio-economic values of the society, which determine whether a technology will be deployed and utilized.

(5) Social wants are not static. The products and services that are produced create new social wants, and in this process, the manipulation of wants through advertising, for example, plays a major role, and thus the spiral:

Social wants ⟶ Products/Services ⟶ New Social Wants →

CONDITIONS NECESSARY FOR THE GENERATION OF APPROPRIATE TECHNOLOGY

The generalized scheme outlined above permits a simple statement of the basic conditions necessary for the generation of technologies appropriate for development:

(1) the filter transmitting demands upon the institutions responsible for technology generation must be consistent with development goals

(2) the guidelines or paradigms influencing the innovation chain must also be consistent with these goals, and

(3) the requisite technological capability must be available.

The filter, for instance, must resolve all social wants into three main categories:

(1) wants which are synonymous with basic human needs, and therefore immediately relevant to development

(2) wants which may not be immediately related to basic needs but must be satisfied for the long-run satisfaction of these needs, and

(3) wants which are irrelevant, or satisfiable for a few only by ignoring the basic needs of the many, *i.e.,* wants which are not in tune with development.

The filter must then selectively transmit the first two categories of wants as demands upon the institutions involved with the generation of technology. For the filter to operate in this way and advance development objectives, the decision-making bodies which control these institutions must be aware of basic human needs, and committed, above all else, to satisfying them.

At the highest levels of decision-making, this awareness and commitment must be expressed explicitly through the share of the R&D budget spent on problems relevant to basic human needs as opposed, for instance, to the luxury demands of the few.

As far as the institutions are concerned, much depends upon the degree of autonomy which they enjoy. If autonomy does not lead endogenously to a commitment to basic needs, they have to be attracted by funds, exhorted or commandeered into such a commitment. If the institutions have little autonomy, it is a matter of chartering or commissioning this commitment. In addition to commitment, an awareness of basic human needs is essential. At the institutional level, this means that there must exist specific mechanisms both for the institution as a whole as well as for its personnel to increase their awareness of basic needs — in other words, an educational process must be set into motion.

The environmental, economic and social guidelines or paradigms influencing the actors in the innovation chain are a crucial aspect of the generation of technologies appropriate for development. Unfortunately, these paradigms are largely un-expressed and un-declared. In fact, the participants in technological innovation are rarely conscious that they cannot avoid using guidelines and paradigms. The net result of not revealing, exposing, and evaluating the paradigms used in the process of technological

innovation in (or for) developing countries is that the participants in innovation fall back on the paradigms of the industrialised countries. But, the factor endowments of developing countries may be fundamentally different from those of developed countries. Under these circumstances, the transfer of all those paradigms related to factor endowments is incompatible with development.

Further, developed countries have largely satisfied the elementary minimum needs for most of their populations, hence their technology is oriented towards other objectives (mainly towards non-essential luxuries and military applications). In developing countries, however, the main preoccupation has to be on elementary minimum needs from which large segments of their population are dis-enfranchised. Thus, guidelines and paradigms related to products and services must necessarily be different in developing countries.

But, what should be the guidelines, preferences and paradigms imbuing the generation of technologies appropriate for development? Unfortunately, an unambiguous and acceptable answer is not available. It is clear that there should be environmental preferences to guarantee the long-term sustainability of development, economic preferences to ensure the satisfaction of basic human needs and the reduction of inequalities between and within countries, and social preferences to promote endogenous self-reliance through social participation and control.

It is even possible to draw up a list of guidelines or paradigms. For instance, the list could be as follows:

GUIDELINES FOR THE GENERATION OF APPROPRIATE TECHNOLOGIES

(1) SATISFACTION OF BASIC NEEDS

(*a*) the technology should contribute, directly or indirectly, immediately or in the near future, to the satisfaction of basic needs such as food, clothing, shelter, health, education, etc.

(*b*) it should produce goods and/or services accessible particularly to those whose basic needs have been least satisfied

(2) RESOURCE DEVELOPMENT

(*a*) it should make optimal use of local factors (manpower, capital, natural resources, etc.) by

* sustaining/generating employment (low capital/labour ratios)
* saving/generating capital (low capital/output ratios)
* saving/generating raw materials, including energy
* developing skills and R&D and engineering capabilities.

(*b*) it should increase the capacity to produce on a sustained cumulative basis

(3) SOCIETAL DEVELOPMENT

(*a*) it should reduce debilitating dependence and promote self-reliance based on mass participation at the local/national/regional levels, enabling the society to follow its own path of development

(*b*) it should reduce inequalities between occupational, ethnic, sex and age groups, between rural and urban communities, and between (groups of) countries

(4) CULTURAL DEVELOPMENT

(*a*) it should make use of and build on endogenous technical traditions

(*b*) it should blend with/enhance valuable elements and patterns in the local/national/regional culture

(5) HUMAN DEVELOPMENT

(*a*) it should lead to creative mass involvement by being accessible, comprehensible and flexible

(*b*) it should liberate human beings from boring, degrading, excessively heavy or dirty work

(6) ENVIRONMENTAL DEVELOPMENT

(*a*) it should minimize depletion and pollution by using renewable resources, through built-in waste minimization, recycling and/or re-use and blending better with existing eco-cycles.

(*b*) it should improve the natural and man-made environment by providing for a higher level of complexity and diversity of the eco-systems, thereby reducing their vulnerability.

The very large number of considerations — environmental, economic and social — that have to be reckoned with implies the necessity of assigning varying weightages to the different guidelines. In other words, in a particular environmental, economic and social context, far greater importance may have to be given to some guidelines than to others. The whole methodology for this exercise of preferences may turn out to be complex and difficult, and needs a detailed study which is outside the scope of this paper[2]. What needs to be stressed here is that it is unlikely that any technology will follow all the guidelines (some may have to be achieved at the expense of others), in which case, technology selection must make the best of a bad bargain. But, the very manner in which the bargain is not ideal suggests how the bargain should be improved, *i.e.,* which guidelines need attention. In this way, the selection and generation of technology are an unending dialectical process.

Nevertheless, with regard to preferences and paradigms to guide the generation of appropriate technologies, several steps have to be taken. Firstly, the prevailing preferences and paradigms guiding technological innovation have to be exposed and made explicit. Secondly, a new set of preferences and paradigms designed to advance development must be formulated. Thirdly, scientists and engineers must be made aware and instructed in the use of the new paradigms. In other words, the generation of appropriate technology requires a paradigm revolution.

The third basic condition necessary for the generation of appropriate technology is technical competence and capability. Though this condition appears obvious and self-evident, it needs stressing for several reasons.

Invariably, appropriate technologies have been confused with low or primitive technologies. This is because, too often, the advanced character of a technology has unfortunately been adjudged with the trivial criterion of scale of production, whereas in fact it should be determined by the extent of the scientific and engineering thinking that goes into the R&D.

It must be admitted here that many appropriate technology groups themselves have been responsible for initiating and perpetuating the belief that the technical capability required for the generation of appropriate technologies is of a lower order than that for western technology. It matters little whether this is due to inadequate understanding or to an attempt to bypass the established institutions of education, science and technology in the developing countries. The net result has been a widespread belief that appropriate technology is "second class" and not modern.

It is clear, however, from Fig. 1 and from the discussion of the filter and paradigms appropriate for development that the only difference between western technology and appropriate technology is the difference in the wants transmitted by the filter and in the set of paradigms guiding the innovation chain. Otherwise, alternative technology needs the same rigour and thoroughness and must be developed from as sound a base of fundamental science and basic engineering as is required for western technology. The importance of this viewpoint must be seen in the context of well-meaning but dangerous advice that developing countries should not invest in basic research. (Even though the share of basic research in the R&D budget of most countries is rarely more than 5–10 per cent). If such advice is acted upon, the result would be highly detrimental to the development of alternative technologies.

Hence, a basic condition for the generation of appropriate technologies is that educational, scientific and technological institutions accept that alternative technology is as modern and advanced and sophisticated as western technology.

THE TECHNOLOGY-GENERATION SCHEME FOR DEVELOPING COUNTRIES

The widespread generation of alternative technologies depends, therefore, upon the fulfilment of three important conditions:

(1) a filter which transmits basic human needs to the technology-generating institutions;

(2) the introduction of a new set of guidelines or paradigms into the innovation chain; and

(3) the existence of the requisite technological capability.

The crucial question, therefore, is to what extent these conditions are satisfied in the developing countries.

An exploration of this question can begin by noting that a causal spiral of the type represented in Fig. 1 is too simplistic in many ways, but particularly with respect to the social homogeneity that it implies. In point of fact, almost every developing country is polarized into a dual society; an elite consisting of the richest 10–20 per cent of the population, which usually includes industrialists, businessmen and feudal landlords, politicians, bureaucrats, rich peasants, professionals such as doctors, engineers and scientists, and the bulk of organized white-collar labour; and the poorest 80–90 per cent most of whom live in the rural areas. It is not too much of a simplification to state that most of the poor of developing countries live in rural areas because the percentage of the total population living in cities of 100,000+ is 11 per cent in Africa, 16 per cent in Asia and 31 per cent in Latin America. Only Argentina (61 per cent) and Uruguay (53 per cent) have more than half the population in cities. If, the percentage below the poverty line is taken as the same in all developing countries, then the above statement is a reasonable zeroeth-approximation. In other words, dual societies (not to be confused with dual economies) are characterized by urban islands of affluence amidst vast oceans of rural poverty. Thus, in effect, a developing country consists of two "societies", which may not be isolated from each other, but are separated by a wide chasm of incomes, consumption, patterns, attitudes, and life-styles.

At the same time, the elite in developing countries practise a philosophy best described thus: "all that is rural is bad, all that is urban is better, and all that is foreign is best", which means that there is a strong influence of the life-styles of the developed countries upon the life-styles of the elite in the developing coun-

tries. Hence, the technology-society interaction scheme of Fig.1 must be elaborated.

A simple version of such an elaboration is shown in Fig. 2 (which is closely related to that proposed by Herrera). It is necessary, however, to make a few comments about this schematic representation.

(1) Little significance must be attached to the sizes of the circles, though

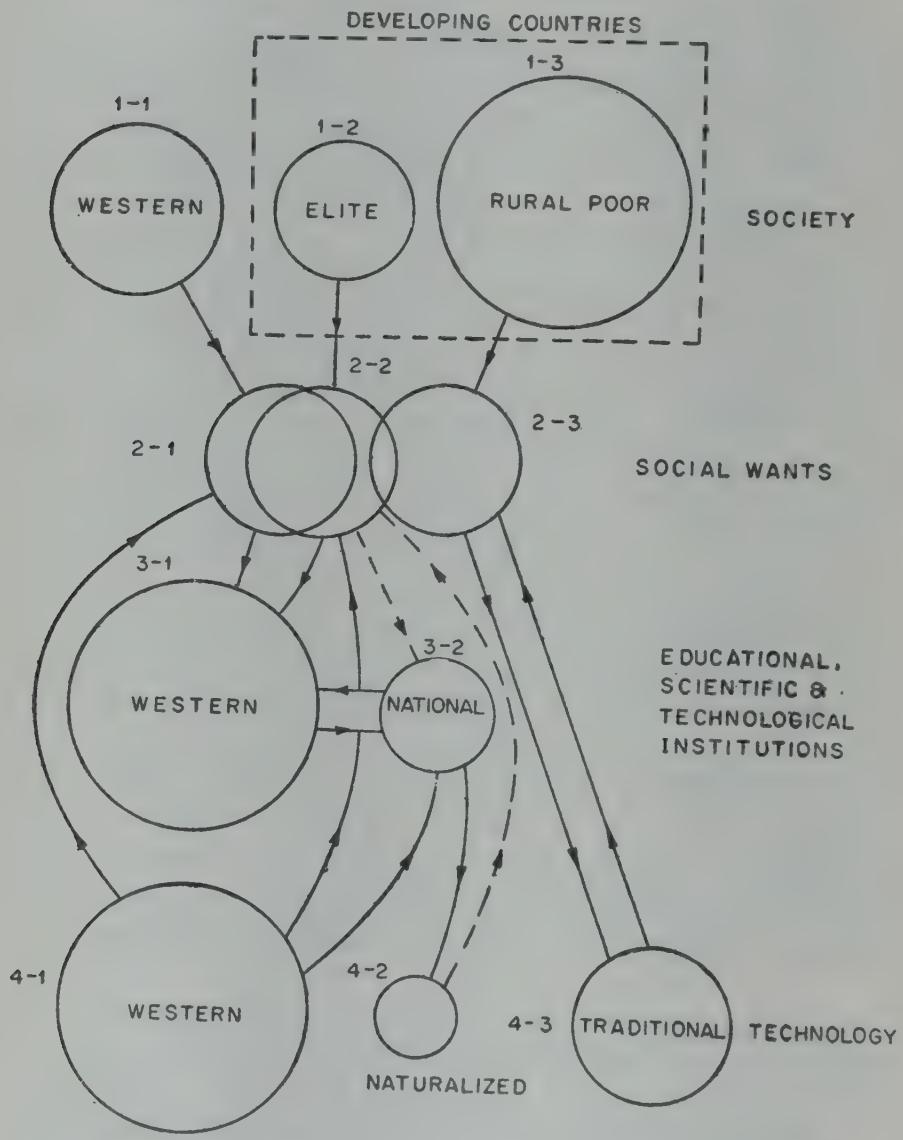

Fig. 2: Technology-society scheme for developing countries.

(*a*) in the case of the row: Society, the circles 1–1, 1–2, 1–3 have been drawn very approximately according to the relative sizes of the populations; and

(*b*) in the case of the rows: Educational, Scientific and Technological Institutions, and Technology, the circles 3–1, 3–2, 4–1 and 4–2 have been drawn very approximately according to the relative magnitudes of the R&D expenditures.

(2) The problem of the urban poor in developing countries is indeed a serious, and more visible, problem. Nevertheless, the urban poor have not been included in the present scheme because

(*a*) their numbers are much smaller than those of the rural poor

(*b*) being subject so much to the powerful demonstration effect of the lifestyles of the urban elite, they share to a considerable extent similar aspirations, and

(*c*) their survival in urban metropolises generates infrastructural requirements similar to those of the elite.

(3) Whereas there is a tremendous overlap between the wants in developed countries and those of the elite in developing countries (cf. circles 2–1 and 2–2), it is a characteristic of a dual society that there is virtually no overlap between the wants of the elite and the rural poor in developing countries (cf. circles 2–2 and 2–3). The elite wants tend to be modelled on the pattern of the developed countries, in contrast to the rural poor whose wants correspond to the very basic minimum needs of food, shelter, clothing, health, employment, etc.

(4) In dual societies, the bulk of the decision-making is in the hands of the elite who are, therefore, responsible for the filtering process which selects out some wants for onward transmission as demands upon the educational, scientific and technological institutions and shelves other wants by giving them relatively little attention. In most cases, this elitist filtering process functions in such a way that

(*a*) the wants of the elite are almost wholly transmitted as demands requiring technological answers, and

(*b*) the wants of the rural poor are largely ignored even though they are an expression of urgent minimum needs.

Since it is the satisfaction of these basic needs which constitutes the essence of development, it follows that an elitist filtering process is incompatible with development.

(5) The demands of the elite are picked up by educational, scientific and technological institutions through the agency of industry in the developing country and of industry in developed countries, both of which sense in these demands a major market. It is important, however, to note that industry in developing countries is of two categories:

(*a*) indigenous industry which derives its technology from the national educational, scientific and technological institutions, and

(*b*) industry which may be owned by government, native entrepreneurs or by multinational corporations (or by two or three of these in different ratios), but which is based on imported technology generated in the institutions of developed countries.

Between these two categories, the linkage of the demands of the elite is very much stronger with the second category of local industry, *viz.*, that based on imported western technology developed by the educational, scientific and technological institutions of the developed countries. This is why the strong linkage 2–2 → 3–1 is shown with a continuous line and the weak linkage 2–2 → 3–2 with a dashed line.

(6) The operation of the filtering process to block the transmission of most of the wants of the rural poor, *i.e.*, the basic minimum needs of the majority of the poverty-stricken population, from the educational, scientific and technological institutions is emphasised by the absence of a linkage between the circle 2–3 and either circle 3–1 or circle 3–2. Of course, the linkage is not zero — for instance, when the rural poor suffer from communicable

epidemic diseases, the elite are also vulnerable, and such needs of the rural poor are obviously responded to effectively. Thus, the filtering process is not conducive to rural development which in developing countries must constitute a major aspect of the development process.

(7) In the absence of institutions to develop technologies to meet the needs of the rural poor, the latter have no choice except to fall back on traditional technologies based on the reservoir of empirical knowledge accumulated through the centuries. (cf. the linkages 2–3 → 4–3 and 4–3 → 2–3).

(8) There is very strong linkage 3–1 → 3–2 between the educational, scientific and technological institutions of developed countries and those in developing countries, the latter being modelled very closely on those of the former. In fact, these institutions in developing countries derive their emerging ideas for R&D, its trends and fashions, its stream of inspiration, its experimental techniques and instruments, its criteria of excellence and its source of recognition from the counterpart institutions in the developed countries. Superimposed on this process is the fact that developing countries receive education and training for a large proportion of their personnel, and in many countries a large influx of expatriates and "experts", from developed countries.

(9) In the generation of technology, the educational, scientific and technological institutions of developing countries invariably start with imported western technology as a starting-point and as a model, hence the linkage 4–1 → 3–2. Thus, they emerge (linkage 3–2 →4–2) after a process of imitation, adaptation and innovation (the innovation, rarely) with a technology which has been described as 'naturalized', *i.e.*, adapted western technology.

(10) The satisfaction of the demands of the elite is much more through western technology (this strong linkage is shown by a continuous arrow 4–1 → 2–2) than through naturalized technology (this weak link is shown by the dashed arrow 4–2 → 2–2).

PROBLEMS OF GENERATING APPROPRIATE TECHNOLOGY IN DEVELOPING COUNTRIES

The above discussion of the technology-society scheme in developing countries leads to important conclusions regarding the problems associated with the generation of appropriate technology in these countries.

Firstly, the characteristics of these dual societies are such that the filters do not emphasise the transmission of basic human needs as demands upon the technology-generating institutions. The magnitude of the R&D funding for problems related to basic needs is usually a clear indicator of this bias, for it is very often significantly less than that for problems related to those aspects of the industrial, agricultural and services sectors devoted to the demands of the affluent elite.

Secondly, the intellectual domination of the developed countries over the educational, scientific and technological institutions in the developing countries leads, in the latter, to a virtually unexamined and unquestioned introduction of alien and inappropriate preferences, guidelines and paradigms into the innovation chain. Consider, for example, the implicit faith in "economies of scale". Strictly speaking, such economies obtain only when there is the requisite infrastructure of energy, raw materials and spares, transport and skills. In developed countries, these components of the infrastructure are rarely all available, as a result of which the consequent under-utilization of capacity undermines, and often destroys, economies of scale. Further, the drive for economies of scale through large-scale capital-intensive units may be perfectly valid in countries where the necessity of generating employment is of negligible importance, but in countries where unemployment is the major problem, the erosion of economies of scale, in the context of serious unemployment, constitutes a serious misuse of capital resources, and an invalidity of the paradigm based on these economies of scale.

Thirdly, there is the problem of the thrust of technological capability. The conscious attempt to emulate the institutions of the developed countries results in the educational, scientific

and technological institutions of the developing countries acquiring patterns of technological capability distorted towards the problems preoccupying the developed countries, *i.e.*, towards problems largely unrelated to the development needs of developing countries. This distortion is only accentuated by the large-scale attempt of developing countries to get their manpower trained in the developed countries, for the most significant result of such training is an increased alienation from domestic developmental tasks. No wonder that most foreign-returned (if they do return) scientists and engineers spend the bulk of their remaining active professional lives continuing the themes of their foreign researches, even though the stark reality outside their laboratories and workshops is clamouring for a local commitment and a native orientation. Among the various reasons for this reluctance to domesticate their talents is the intellectual difficulty of doing so in the absence of a sound knowledge of the fundamentals of the subjects underlying and linking the foreign and domestic problems. For example, only a thorough grasp of aerodynamics and structures permits a facile switch from the design of jet-fighter wings to that of waterpumping windmills.

AN APPROACH TO THE GENERATION OF APPROPRIATE TECHNOLOGY

This analysis of the problems associated with the generation of appropriate technologies in developing countries suggests certain obvious prerequisites for overcoming these problems.

The first prerequisite is the establishment of clear-cut mechanisms to alter the filtering process so that the relevant institutions respond to, and are biased towards, basic human needs, especially the needs of the neediest. These mechanisms must be directed towards the creation of an awareness of these needs and a commitment to satisfying them. However, a precondition for this alteration is a political framework which sanctions, or at least does not prohibit, such a new filtering mechanism. Given such a framework, much depends on the decision-makers who control R&D funds, and on the existence within educational, scientific and technological institutions of leadership and core groups which

generate an increasing response to the basic needs of the poor, rather than to the non-developmental demands of the elite.

The second prerequisite is that the scientists and engineers involved in the generation of appropriate technology should absorb and/or formulate the new preferences, guidelines and paradigms essential for the development of appropriate technology. Absorption is of course an easier process than formulation, but unfortunately the new preferences, guidelines and paradigms have not yet been elaborated and made explicit. This situation only increases the intellectual burden on (challenge to?) scientists and engineers, and compels them to understand the economic, social and environmental ramifications and implications of their areas of interest. This understanding requires, in addition, close contact with the prospective beneficiaries of appropriate technology, *i.e.*, the population in rural areas, particularly the poorest sections.

The third prerequisite is a new pattern of technological capability, since the task of generating appropriate technology appears to be impeded by the type of technological capability that developing countries have and are currently growing, and the pattern of linkages that their educational, scientific and technological institutions have and are forging with domestic and foreign societies. Thus, most developing countries have followed a standard approach of establishing universities, institutes of science and/or technology, technical institutes and industrial laboratories modelled on the corresponding institutions in the developed world, with even their staff emulating counterparts in the industrialized world. As for the institutional linkages, Fig. 2 shows that the strongest ones are with the demands of the elite, with their counterpart institutions in the developed world, and with western technology. Furthermore, because of financial stringencies, these institutions — like naturalized technologies — just become cheaper and cruder versions of the corresponding western institutions.

After a decade or two of their operation, it becomes apparent to the national governments, which are under political pressure from the poor, that these institutions are making little contribution to the tasks of development. And thus arise the pleas and the

exhortations to these institutions to devote themselves to the problems of the needy. But, such appeals hardly work.

The reasons for this predicament are discernible from the technology-society interaction scheme for developing countries (Fig. 2). This predicament is an inevitable consequence as long as institutional linkages are virtually non-existent with the needs of the rural poor and with traditional technologies (see the absence of arrows interconnecting circles 3–2 to 2–3 and 4–3), and are very strong with elite demands, with institutions in the developed world and with western technology (see the arrows interconnecting circle 3–2 with circles 2–2, 3–2 and 4–1). The situation is worsened by the fact that most teachers, scientists and engineers are drawn from, and become part of, an elite which in the dual society of developing countries is virtually cut-off from its countryside and its rural poor. No wonder they are more familiar with London or Paris or Los Angeles than with villages even a few kilometres from their institutions.

But, there is an alternative strategy for developing countries to satisfy the prerequisite of a new type of technological capability necessary for the generation of technologies relevant for development. This strategy follows from Fig. 2, and consists of two components:

(1) forging strong linkages between the educational, scientific and technological institutions of these countries and the needs of the rural poor and their traditional technologies, and

(2) drastically weakening the linkages of these institutions with elite demands and with institutions in the developed world.

There have been few studies of this alternative strategy even though it appears much more promising than the standard discipline-oriented sectoral approach which has proved such a dismal failure. But, the indications are that it may prove to be a cheaper, faster and more effective approach of growing a technological capability relevant for the generation of appropriate technologies. But,

apart from an unwavering political commitment to development, the alternative strategy needs simultaneous implementation at a hierarchy of national, sub-regional and institutional levels.

The national or macro-approach should be directed towards the preparation and on-going modification and refining of technology plans for development. This technology planning should be linked with the process of selecting and choosing technology for development, so that better technological options than those available can be identified, and research and development work towards the development of these technologies can be initiated. Of course, insights into these alternative technological options can only emerge from greater sensitivity to the problems of the rural poor and more intimate contact with their problems. Such sensitivity to needs and intimacy with problems cannot be attained by planning from the cloistered chambers of the national capitals of developing countries. What is necessary is inputs from the grass-roots level, and herein lies the importance of work at the institutional or micro-level.

The educational scientific and technological institutions of developing countries have, at least in an embryonic and rudimentary form, the multi-disciplinary competence to tackle the task of developing appropriate technologies for meeting the basic needs of the needy, particularly in rural areas. These functioning institutions must constitute the main basis for the generation of appropriate technology through a deliberate and formal commitment to the problems of development, and particularly to rural development. Such a re-deployment of efforts with the existing infrastructure is a far more effective measure than the creation of new institutions for appropriate technology.

The activities of institutions at the micro-level can be linked together interactively at the sub-regional or meso-level, *i.e.*, at the level of districts or groups of districts corresponding to the next higher level of local government. Here too the basic approach should be a commitment to the problems of a particular area of the country and to the problems of the poorest sections of the people in that area.

This alternative strategy of generating technological capability and developing technologies through a commitment to the poor and their problems is likely to ensure satisfaction of the third prerequisite for the generation of appropriate technologies, *viz.*, the growth of a new type of technological capability. In addition, this same strategy is also likely to satisfy the first two prerequisites. Thus the establishment of close links between educational, scientific and technological institutions on the one hand, and the villages and rural poor on the other, is the surest way of creating an awareness of the basic needs of the neediest. If this awareness is transformed into a commitment to rural development, then the institutional and personal filters will start responding to those social wants which correspond to the basic needs of the poorest, without which response the generated technologies will not be compatible with development objectives. Similarly, it is only the close contact with rural areas and those below the poverty line which will facilitate the formulation of guidelines and paradigms consistent with true development.

The adoption of this alternative strategy is bound to have several other important implications:

(1) A most important weakness of R&D institutions in developing countries has been in the aspect of the innovation chain concerned with scaling-up. But the key feature of many (but not all) appropriate technologies is that they aim at a minimisation of scale. Thus, the weakness of these R&D institutions vis-a-vis large-scale technology vanishes vis-a-vis the mini-appropriate technologies. These institutions can therefore grapple from a position of strength with the task of generating appropriate technologies.

(2) Since expenditure on R&D rises more than proportionately with the scale of the ultimate production units, much smaller funds are required for R&D on the alternative technologies of scaled-down, dispersable, miniaturized production units. In other words, far greater returns can be realized from a given R&D expenditure by a developing country if it turns away from western technologies to alternative technologies.

(3) At the same time, a commitment to appropriate technologies will compel the educational, scientific and technological institutions of developing countries to turn away from the developed countries and towards the local people and their problems. This attempt to strike native roots is bound to have an invigorating influence on science, and perhaps lead to its exuberant growth. Appropriate technologies will also bring scientists and technologies into contact with the countryside and the vast majority of the population. This will have a mutually educative influence and, in the long run, this influence alone will resolve the inevitable problems of language and communication characteristic of the present dual society. It is also this contact which will, on the one hand, bring science and its methodology to the masses, and on the other hand, release their creative energies for the development of a non-elitist science and technology.

(4) Finally, indigenous educational, scientific and technological institutions, stimulated by the challenge of local problems and inspired by the vision of true relevance, are bound to grow in strength and acquire excellence. The differences in their milieus will guarantee their uniqueness and individualities, the similarities in the problems and surroundings will motivate interaction and collaboration, and when this happens in all developing countries, there will begin a process of genuine collaboration between the educational, scientific and technological institutions of these countries which is a sure basis of the New International Economic Order in history.

GENERATION OF TECHNOLOGY

Though it is not the primary purpose of this paper to deal with the diffusion of technology, this aspect of technology cannot be avoided. For one thing, technology generation for its own sake is a sterile exercise; for it to have meaning and purpose, it must lead to the diffusion of technology. In fact, the generation and diffusion processes should be dialectically linked, so that each implies and conditions the other.

But, the need for this dialectical relationship must not be allowed to blur the crucial differences between the two processes.

Unfortunately, this blurring takes place too often, and it is therefore necessary to make the differences explicit.

Firstly, the 'actors' in the two processes are different — whereas R&D institutions (at the macro-, meso-, and micro-levels) are responsible for technology generation, the process of technology diffusion is usually the responsibility of a development agency, acting in coordination with the people, local self-government organs, R&D institutions, financial and credit institutions, and marketing organizations. Thus, technology generation can be achieved by the 'solo' effort of R&D institutions, but technology diffusion must be a multi-institutional effort.

Secondly, the funding agencies for the two processes are usually quite different — technology generation is funded by R&D grants from government ministries, and public and private sector industries, but technology diffusion is funded by development expenditures.

Thirdly, the technology generation process is much more autonomous than the technology diffusion process, in that, given (*a*) funds for R&D, (*b*) sufficient awareness and commitment among those doing R&D, and (*c*) the absence of direct political hostility towards the R&D, the generation of technology appropriate for development can be accomplished successfully. In contrast, technology diffusion cannot be achieved against the wishes of the ruling groups in society. And, where the technologies to be diffused are against the vested interests of the privileged — which they invariably are in dual societies, if they are indeed technologies appropriate for development — then the success of the diffusion depends on the particular balance of power between various groups in society. The ruling group is rarely homogeneous, and if, within this group, the more powerful sections, e.g., the urban elite, are not inimical to the technology diffusion in rural areas, then the process stands a favourable chance. If, on the other hand, all the privileged sections are unitedly opposed to the technology, then the attempt to diffuse it is an integral component of the efforts of the under-privileged for a more just and equitable society. Thus, a necessary condition for the successful diffusion of technologies appropriate for develop-

ment is a large measure of active political support from the rulers of society.

Fourthly, the power structure is not necessarily disturbed by the generation of technology, but it cannot but be affected by technology diffusion.

Fifthly, the levels of operation of the two processes are quite different — technology generation can be achieved at the institutional level; technology diffusion must be accomplished at the level of a society (even a village is a mini-society).

Sixthly, the role of the people in the two processes is quite different. Though close consultation with the people provides better insight into local needs, traditional solutions, local conditions, local materials and local skills, and though these insights are quite essential for ensuring the appropriateness of technology, an R&D institution can in fact generate technology without the active participation of the people in the design, calculations, experiments, fabrications, etc. In other words, appropriate (including socially acceptable) technology is unlikely to be generated by R&D institutions without close consultation with the people, but their active participation in the technology generation *per se* is not necessary. In contrast, the active participation and involvement of the people is a necessary condition for technology diffusion.

These distinctions between technology generation and diffusion, particularly between social consultation and single-institutional work for technology generation *vs* social participation and multi-institutional work for technology diffusion, lead to some important perspectives and conclusions. For instance, it is clear that institutions of education, science and technology can assume — and successfully discharge — the responsibility of generating appropriate technologies. If, however, these institutions assume the responsibility for diffusion of technology, they must realize that the following consequences will ensue:

(*a*) they will have to lead, coordinate and manage the concerted action of a large number of institutions, *viz.*,

development agencies, local self-government organs, financial and credit institutions, marketing outlets, etc.

(*b*) they are almost sure to deviate from their charters of education, science and technology.

Whether they are structured and competent to discharge this onerous responsibility is a moot question. In general, it would be unwise for educational, scientific and technological institutions to assume the responsibility for technology diffusion without being aware of all the implications and consequences. On the other hand, R&D institutions must be an essential part of the technology diffusion process — the vital need for their active participation in the process follows logically from the linkage between the technology generation and diffusion processes.

In conclusion, therefore, micro-level institutions of education, science and technology can, and should, assume leadership in technology generation, but not in technology diffusion — they should only be members of the multi-institutional teams to diffuse technology.

This conclusion need not be valid in the case of macro- and meso-level institutions of science and technology, for example, national and provincial councils or departments for science and technology. Such councils and departments, by their very nature and responsibilities, are already removed from the laboratories, offices, drawing-boards and workshops where actual R&D work takes place, and are in fact, performing, catalysing and co-ordinating R&D work. Hence, macro- and meso-level institutions may be better equipped — compared to micro-level institutions — to lead the process of technology diffusion. But, for such leadership to be effective, it should be formally accepted by all the concerned institutions — development agencies, local self-government bodies, financial institutions, etc. Even in the absence of such a formal acceptance of the leadership of a macro- or meso-level institution of science and technology, it can still play a powerful catalytic role in the diffusion of technology. If size and complexity of organization are an inverse measure of its speed and effectiveness, then it may turn out that macro-level institutions are too ponderous

and ineffectual to play the catalytic role efficiently. The hope for successful technology diffusion may, therefore, lie in the hands of meso-level provincial councils for science and technology.

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PROBLEMS IN THE GENERATION AND DIFFUSION OF APPROPRIATE TECHNOLOGIES

ASTRA—AN INSTITUTIONAL EXPERIMENT

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GENESIS AND OBJECTIVES OF ASTRA

The conceptual analysis presented in the first part of this paper has guided, and in turn been shaped by, an experiment now in progress at the institutional level.

This experiment is being undertaken by one of the oldest and most well-known institutions of higher learning in India — the Indian Institute of Science, Bangalore. Founded in 1911, this Institute has a faculty of about 300, and a student body of slightly under a 1,000, of which about 400 are doing graduate work towards a Ph.D. degree and roughly another 350 are engaged in master's level studies, the remainder carrying out bachelor's level studies. With about 20 departments of science and engineering, the Institute has, at several junctures of its history, played an innovative role in Indian education, science and technology.

In 1973, a few faculty members, quite oblivious of thinking going on abroad, arrived at some of the basic ideas of appropriate technology through their analysis of Indian science policy. Being scientists and engineers, they felt an obligation to reflect these ideas in their technical work. Further, coming as they did from various disciplines and departments, they realized the need to come together as a catalytic group based initially on a loose identity of purpose and community of spirit.

The authorities of the Institute soon gave official approval to this desire, and thus ASTRA (Loosely translated, ASTRA means "weapon" in Sanskrit), an acronym for Application of Science and Technology to Rural Areas, came into existence on August 20, 1974.

ASTRA's initial viewpoint was expressed in a statement from which the following excerpts are relevant to the present discussion.

"It is becoming increasingly clear from the experience of India and other developing countries that the benefits of urban industrialization, intensive agriculture and medical progress have not trickled down to the rural poor to the extent hoped for and expected. One major reason for this situation is the uncritical import and adoption of the technologies of the advanced countries".

"By becoming more and more intensive with respect to capital, energy and skills, imported industrial technologies gravitate away from the countryside and towards urban centres. By emphasising an agriculture which requires massive investments on machinery, irrigation and expensive inputs (seeds, fertilizers, pesticides, etc.), the benefits of the green revolution accrue almost wholly to the rural rich. By diverting attention, firstly to the curative rather than the preventive aspects of medicine, and secondly, to diseases arising from affluence rather than poverty, the exploitation of medical advances does not help the rural poor in any significant measure. By concentrating on luxury goods and services which have a higher import content than goods and services for mass consumption, the technologies of the advanced countries increase the import bill of the country and cater only to an elite. By demanding raw materials which are not available locally, they increase imports and/or load the struggling transport system and thereby necessitate dependence on fossil fuels. By originating largely from the interests of private enterprise, these foreign technologies are inimical to the rational utilization of public resources such as soils, waters, grasslands and forests; the result is a steady loss and degradation of these resources. By consuming non-renewable materials, they squander precious natural resources.

By pursuing an ever-increasing scale of production, these imported technologies become critically dependent on a supply of raw materials, energy and skills too large to sustain with ease under Indian conditions — the result is long gestation times and under-utilisation of industrial capacity. Above all, by emphasizing the saving of labour, they accentuate the already-acute problem of unemployment. Thus, given this country's resources (including manpower), an indiscriminate adoption of the technology of advanced countries results in rural impoverishment, balance-of-payments difficulties, crises of raw materials, energy and skills, under-utilization of industrial capacity, growing income inequalities, large-scale migration to cities and mass unemployment".

"It is imperative therefore to consider a totally different approach to development in which the starting point is the following set of facts:

(1) four-fifths of India's population lives in the villages
(2) three-fifths of the population has a per capita expenditure of less than one rupee per day
(3) about 20 millions are unemployed and 100 millions are under-employed".

"This starting point suggests that a valid development strategy should be based, not wholly on the technologies of the advanced countries, but on alternative technologies that facilitate low capital investment, employment generation in rural areas, dispersal of mini-production units to the villages and production of inexpensive goods and services of the mass consumption variety. Only such alternative technologies can lead to reduced inequalities through the poorest sections of society having more to spend by virtue of greater employment and at the same time having access to inexpensive essential goods and services which can be bought with the greater earnings. Thus, alternative technologies are technologies that are directly in the interests of the unemployed or under-employed rural poor".

"Despite the vital necessity of developing these alternative technologies, it is unfortunate that the challenge has not been taken up by more than a few institutions. These few institutions

may be committed, and commitment is, of course, a necessary condition, but it is not sufficient. Competence too is required, particularly because alternative technologies cannot be — as they often are — confused with primitive technologies. In fact, alternative technologies can be quite advanced in that they may require sophisticated scientific and engineering thinking".

"Only major scientific institutions possess the multi-disciplinary competence which is often necessary to tackle the task of developing alternative technologies. Unfortunately, however, not a single institute of advanced study has interested itself in the challenge, perhaps because their criteria of excellence are derived from alien soils or because alternative technologies are not viewed as glamorous enough to merit attention. At the same time, these institutions have been engaged in a desperate quest for relevance, but this relevance has been almost universally interpreted to mean relevance to large-scale industry and urban problems. The possibility of relevance to rural problems has been scarcely considered".

"It is amidst the above background that the Indian Institute of Science has created ASTRA".

"What is being attempted is not a change in the techniques, methodologies and quality of the current programmes of the Institute, but the definition of a new vista with regard to the ultimate end-products of these efforts. (Thus, the techniques used for the design of aeroplane wings can equally well serve the development of low-cost windmills, and researches in bacterial fermentation and in the chemical engineering of reactors can be used for the scientific design of bio-gas plants). The new perspective is such that the present total neglect of rural problems will be transformed into a partial emphasis on work relevant to the needs of the rural poor".

"The objectives of ASTRA are that it should: (i) serve as an agency for increasing the Institute's awareness of the rural situation; and (ii) play a key role in correcting the present urban bias in the educational, research and development programmes of the Institute so that a significant fraction of these programmes acquire a rural orientation".

"In order to achieve these objectives, it is envisaged that ASTRA will, in the first phase of activity: (1) catalyse the development/testing of village-oriented technologies on the Institute campus; (2) establish an Extension Centre in a village near Bangalore; (3) transfer developed/tested technologies either to the village through the Extension Centre or to other rural development agencies".

"The main emphasis in this initial phase is on the Institute educating itself about rural reality, particularly about age-old techniques, empirical knowledge, the problems of those below the poverty line and their response to technologies developed in urban settings".

"The necessity for this educational phase cannot be overstressed. The standard approach of western-oriented elite institutions is to assume that the needs of villages and of the rural poor can be met with cheaper and cruder versions of imported urban technologies. Not only does such an approach inevitably end up with capital-intensive and labour-saving technologies, but it accentuates the debilitating dependence of the villages upon the cities and does damage to the fabric of village life. A more appropriate approach is to start with a scientific study of traditional life and technologies and generate qualitative changes with minor alterations and improvements. This presumes, however, a depth of understanding of villages and their poorer sections that can only be acquired by a process of education in the countryside".

PRELIMINARY WORK OF ASTRA

In its first year of operation, ASTRA sought to stimulate the interest of faculty and students in rural problems by holding seminars and discussion meetings on a wide variety of subjects such as bullock-carts, bicycles, rural schools, solar energy, bio-gas plants, rural housing, hand-pumps for drinking-water wells, monsoon prediction and agricultural planning, algae as food, fuel and fertilizer, and small-scale manufacture of cement and paper.

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These seminars attracted unprecedented interest on the campus, as a result of which work on about 12 projects was initiated during the first year. This work involving over 25 faculty members is at present focussed on windmills, hand-pumps, bullock-carts, bicycles, rural housing, low-cost teaching materials, bio-gas plants, small-scale lime pozzolana cement plants, sodium silicate from rice husk, solar air-conditioning. fluidyne engines and Humphrey pumps.

Very few such motivational seminars were held during the second year, but the momentum of project generation continued with the result that about 33 faculty members, 15 project assistants and 21 students were working on about 35 projects. These projects included many which were started during the first year (but, not all of them, because a few petered out for lack of manning); in addition, many new projects were started including field studies of rural energy consumption patterns, silk-worm studies, heat pipes, bio-gas melting furnaces, ferrocement roofing, edible cellulose from rice husk, rammed earth construction and soil-cement blocks.

To choose a suitable location for the proposed Extension Centre, faculty members in groups of 3–5 members have made 15 trips during the first year of ASTRA's existence to about 25 villages in the vicinity of Bangalore. Based on these visits, it was decided that the Extension Centre should be located in Ungra village (Kunigal Taluk, Tumkur District) about 115 kms from Bangalore and on the banks of the Shimsha river. The area holds out possibilities of work on small-scale sugar and jaggery plants, bagasse-based hand-made paper, castor-oil based plastics, rice-husk and rice-bran oil products, activated carbon from coconut shells, glass from river sand, cement plants from local limestone, silkworm rearing, etc. In addition, there are weavers, potters, black-smiths, bullock-cartwrights and brass workers in the region. The Government of Karnataka has leased about 50 acres of unused land on the periphery of Ungra village so that the Institute can establish its Extension Centre.

The following work at the Ungra Extension Centre is in progress:

(1) a techno-economic and energy-consumption pattern survey of Ungra and the surrounding villages is being carried out in order to define the technologies appropriate for development in the area

(2) a master-plan for the Extension Centre campus and plans for the individual low-cost buildings has been finalized, and construction will begin shortly, and

(3) a study of Ungra village viewed as an ecosystem is being undertaken.

ASTRA'S RESPONSE TO BASIC NEEDS IN RURAL AREAS

Though it is too early to assess the whole experiment, it is useful to attempt some evaluations.

At the outset, there should be an evaluation of whether the desired change is occurring in the filter which makes Institute faculty ignore some social wants and treat others as demands upon their scientific and engineering capability. In particular, despite the large measure of freedom to choose problems, the faculty of the Institute, as of most other institutions of higher learning in India, have hitherto ignored rural problems. In other words, the filter, has thus far rejected rural problems, and transmitted urban and large-scale industrial problems, and of course the problems fashionable in the advanced countries. Is this operation of the filter changing?

The first major objective in the initial phase of ASTRA's work was to become aware of developmental problems in rural areas. The two sub-objectives were:

(1) to become aware of problems relevant to rural areas, and particularly to the rural poor, and

(2) to formulate the technical component of these problems as technical problems worthy of R&D.

With regard to the first sub-objective, there has been reasonable success, especially in the case of those faculty members who have been able to make a number of visits to villages. The rapidity

with which trained scientists and engineers can become aware of the essential technical problems has been very encouraging. In so far as these faculty members have acted as liaison with the rural countryside, the diffusion of their awareness throughout the Institute has depended upon their ability as communicators and proselytizers, and upon the interest and receptivity of those other faculty and students who have not been able to visit the rural areas for logistical and other reasons. This diffusion has met with partial success — the seminars have played a major role in this process — but it is obvious that awareness is not easy to come by through "second-hand" experience. At least the logistical problem of enabling faculty and students to see things at "first hand" has to be overcome. The establishment of the campus in Ungra village will obviously be a great help in this matter.

The formulation of technical problems relevant to rural development, *i.e.*, the identification of technologies that need to be generated, has been a commendable success. In fact, the actual number of ASTRA projects is far, far less than the number of new problems continuously being posed. What is not certain is whether the solutions to these technical problems, *i.e.*, the technologies generated, will actually advance rural development, e.g., will reduce income inequalities. This will depend on whether the technologies are intrinsically appropriate for development and whether they can and will be deployed and diffused.

It appears, therefore, that the problem of increasing awareness of rural reality has been overcome to some extent. The factors which have facilitated this limited success are: (*a*) the support of the Institute authorities for ASTRA's efforts — the Council of the Institute has commended ASTRA's work, a reasonable budget has been allocated to ASTRA, and the Institute has backed the Extension Centre experiment by taking on lease the land in Ungra village; (*b*) the existence of a small group of highly qualified scientists and engineers interested enough to explore rural areas. The factors which have diminished the extent of success are : (*a*) the logistical problems in moving faculty and students to make visits to the countryside; and (*b*) to a smaller extent, the cynicism and apathy on the part of some faculty and students

towards the ASTRA experiment — the "why-change-our-work-routine?" and "it-won't work" attitudes-, and the rejection of its underlying philosophy by some others — "there is no point wasting effort on reshaping the instrument of technology when the socio-political will to use technology for development ends is weak".

But awareness of needs is only one aspect of the problem; an equally vital aspect is sufficient commitment to work on the problems which have been identified — the second major objective in ASTRA's initial phase. The initiation of about three dozen projects within two years constitutes a definite achievement. The fact that a few scientists of international standing have made the commitment and that ASTRA's activitists have not been dismissed as crackpots underlines the achievement. It is not certain, however, whether the achievement is a result of the zeal of ASTRA's activists, or of the first wave of enthusiasm for a new concept of the Institute's mission, or of attraction to a project supported by the Institute leadership.

But, commitment as an institutional or group characteristic is a dynamic phenomenon — it either grows or decays. Thus, the initial commitment expressed through active participation in projects is promising, but cannot be taken for granted and cannot guarantee sustainability and growth. This commitment can be seriously affected by both personal and institutional factors.

The factors which will promote an increased commitment include:

(*a*) Institute recognition, through the concrete mechanisms of funding and new criteria for faculty assessment, to R&D work on what are elsewhere considered as banal, insignificant and trivial problems (A separate budget has been allocated for ASTRA, and it has been asked to prepare a working paper on the assessment of faculty engaged in ASTRA projects).

(*b*) the availability of adequate funds for R&D, despite the fact that appropriate technology generation requires about an order-of-magnitude less funds than western technology (Thus far, ASTRA has obtained as much funds

as it can cope with, and in addition, has taken the view that funds from international agencies are unnecessary, even when offered).

(*c*) the achievement of major successes in at least a few of these projects (The projects on hand-pumps and windmills appear to have achieved breakthroughs, and the studies on rural energy consumption patterns and alternative energy sources, particularly bio-gas, have attracted international attention).

(*d*) extra-institutional acclaim from the government and other institutions, and/or the people (There has been an enormous amount of *interest,* as indicated by the large number of enquiries and visitors, but interest does not necessarily mean acclaim).

(*e*) the development of a new comradarie and ethos characteristic of new movements (Few other interdisciplinary, interdepartmental programmes in the Institute have succeeded in forming as many friendships and personal bonds).

(*f*) a growing conviction of the social responsibility of scientists (Such a growth of conviction will probably require the work of ASTRA to be part of a wider mission of socio-economic transformation).

(*g*) the realization that in problems relevant to the neighbourhood it is local scientists and engineers who enjoy an incomparably greater advantage over their foreign counterparts in the matter of intimacy with the subtleties of the problems and with the feasibility and acceptability of the solutions (This realization is slowly forming, thanks to the growing numbers of foreign visitors anxious to know about ASTRA's work); and

(*h*) the growth of a new international and national community of scientists and engineers committed to appropriate technology (Such a community is forming quite fast).

On the other hand, the factors which will militate against increased commitment to appropriate technologies are:

(*a*) the emergence of a political hostility to development objectives, and to the technologies appropriate for achieving these objectives

(*b*) persistence, on the part of the Institute, with traditional criteria for assessment of scientists and engineers, e.g., number of papers in foreign journals, work in so-called "frontier areas", etc.

(*c*) fear that the career and employment prospects of faculty and students will be jeopardized by not working on problems relevant to large-scale industry

(*d*) reluctance to deviate from the comfortable cocoon of problems which, irrelevant to basic needs and development, have been the central preoccupation hitherto and the main object of considerable intellectual investment bringing *kudos*, publications, invitations to international conferences, etc.

(*e*) fear of facing the cruel test of practice — 'the wind-mill may not turn', or 'the bio-gas plant may stink', or 'the 'innovative roof may collapse' — in contrast to scores of erudite papers which are rarely read and still more rarely cited

(*f*) difficulty in gaining access to information and contacts relevant to the new technologies, and

(*g*) refusal to cross social barriers in order to understand, empathize and identify with the under-privileged.

How the balance will be titled by these opposing sets of factors is not easy to guess. But, the initial commitment manifested through the commencement of work on about a dozen ASTRA projects is extremely encouraging and cannot be evaluated as a failure.

The two major objectives of the first phase of ASTRA's work, *viz.*, increasing awareness of rural reality and generating a commitment to appropriate technologies, relate in the conceptual analysis[1] to the whole question of a change in the operation of the filter which generates demands upon the institution responsible for technology. The ASTRA experience shows that, in situations

similar to the one in which it worked — funds, autonomy, capability, etc. — educational, scientific and technological institutions in developing countries can operate the filter so as to respond to problems related to the basic minimum needs of the population. Since such an operation of the filter is one of the basic conditions for the generation of appropriate technologies, this part of the picture is not bleak.

ASTRA'S EXPERIENCE WITH NEW GUIDELINES FOR TECHNOLOGY GENERATION

Attention will now be turned to the second basic condition for the effective generation of appropriate technologies, *viz.,* the evolution and use of a new set of guidelines and paradigms in the innovation process. The ASTRA experience in this matter is quite scanty and the results are too inadequate to draw conclusions. Nevertheless, in the absence of guidelines agreed upon between scientists, engineers, economists, sociologists and environmentalists, ASTRA has had no alternative but to go ahead and use its own loosely formulated set of *ad hoc* guidelines. It is this *ad hoc* set of paradigms which may be worth sketching. Of course, it must be noted that the first round of ASTRA projects were started primarily to initiate interest on the Institute campus in topics of rural relevance. It was considered far more important to get the work started, than to wait for well-founded guidelines for technology generation to be elaborated. The chances of inappropriate technologies being transferred to the Extension Centre were considered to be small, because a process of estimating the technological impact on the village scene would intervene between technology generation on the Institute campus and their transfer to the Extension Centre.

Satisfaction of basic needs, starting from the needs of the neediest

The 35 projects that have been started are directly relevant to basic needs in villages, and the distribution is roughly as follows:

Basic Need	Number of projects
Food ..	4

Clothing	..	—
Shelter	..	9
Health	..	1
Education	..	1
Employment	..	9
Transport	..	2
Energy	..	5
Miscellaneous	..	4
		35

Some comments need to be made on this distribution:

(*a*) The distribution of projects over the basic needs is not intended to define any priorities between these needs; it only underlines the fact that the expertise in the Institute is channelled more in certain directions than in others. For instance, there is scarcely any agricultural expertise in the Institute, and the projects counted under the item — Food, really pertain to water pumping for irrigation. However, it may be possible to build up expertise in agricultural engineering, particularly after agricultural operations start at the Extension Centre in Ungra village.

(*b*) With about 18 projects biased towards the consumption of basic needs, in contrast to about 4 projects directed towards production, and 9 projects having both consumption and production implications (the rest are not easy to allocate between production and consumption), the initial bias of ASTRA appears to be towards consumption technologies. Of course in the case of consumption technologies, it is relatively easier to estimate whether it is the neediest who are likely to benefit from the technologies which are generated. Production technologies, if not carefully chosen, can aggravate income disparities in rural areas (cf. many green revolution technologies); hence, it is necessary to avoid being blinded by the euphoria of "helping villages" into making matters worse for the rural poor by introducing production technologies which primarily benefit the rural rich.

USE OF LOCAL RESOURCES

The conscious aim in all the ASTRA projects is to maximize the use of local resources, both natural and human. This is ASTRA's most clear-cut guideline for the generation of technologies appropriate for development. The guideline is being implemented, for instance, in the area of energy (locally available, non-depletable sources such as bio-gas, wind and sun), shelter (e.g., stabilized mud blocks for walls), processing of agricultural wastes (e.g., edible cellulose from rice husk).

LOCAL SELF-RELIANCE

The emphasis on the use of local natural and human resources will tend to strengthen local self-reliance, but self-reliance of villages is not in itself a sufficient objective unless it leads to greater social participation and control. In other words, alongside with increased self-reliance of villages vis-a-vis cities, the technologies which are introduced must not strengthen the dominance of dominant groups in villages. What impact ASTRA's work will have in this matter is too unclear to comment on at present.

REDUCTION OF INEQUALITIES

ASTRA's efforts must be pronounced a failure if it aggravates inequalities in rural areas. One way of avoiding such a disastrous result is to ensure that newly-introduced production technologies are at least associated with significant employment generation (*i.e.*, low capital-labour ratios), if the production cannot be carried out under cooperative or *panchayat* ownership This whole issue acquires increasing significance particularly because, in the excitement of generating technologies based on locally available agricultural wastes, new avenues of profit-making may be generated for the local elite. All this means that ASTRA must give as much thought to who will benefit from production technologies as to the intricacies of the technologies. Hence, attention must be given to the whole software package (ownership structure, credit, management, raw materials procurement, product marketing), and not only to hardware development. Thus far, ASTRA has taken few steps in this direction.

STRENGTHENING TRADITIONAL TECHNOLOGIES AND CULTURE

ASTRA has started off with a low profile in the cluster of villages around the Ungra Extension Centre so that the interactions may be built on technologies, rather than on speeches and promises. So far, interactions have taken place with village wheelwrights who make and repair bullock carts and with villagers on the design of houses. Interaction will shortly take place with village carpenters on wind-mill fabrication, with village masons on construction of the Extension Centre buildings, and with village youth having acknowledged mechanical skills on hand-pump repair and maintenance. There has been some interaction with village potters and blacksmiths, but not sufficiently enough to contribute to their traditional technologies. Thus ASTRA has made some, but not significant, moves to understand and transform traditional technologies and skills.

ASTRA AND TECHNOLOGY DIFFUSION AND UTILIZATION

Technology is only an instrument for the development of society. If development objectives are to be achieved, the instrument of technology, like all instruments, must be specifically chosen and designed for its intended function, *i.e.,* it must be appropriate to the objectives. But, the will to use the instrument, and the skill to wield it effectively, does not depend so much either on the instrument (the technology) or on the fabricators of the instrument (the R&D institution) as upon the users of the instrument (society and its political, social and economic organizations). Thus, the generation of appropriate technology is a necessary condition for development, but not a sufficient condition. In addition, the technologies must strike root and spread, and the fruits of the technologies must reach those whose basic needs have been least satisfied.

In this total development process, involving the generation-diffusion-utilization of technologies, an R&D institution can only ensure the generation of appropriate technologies, but the responsibility for the diffusion and utilization of technologies should not be assumed, and cannot be successfully discharged, by an R&D institution, particularly an educational institution like the Indian

Institute of Science. The diffusion of technologies requires the coordinated cooperation of a number of institutions and agencies — social institutions like *panchayats* and *zilla parishads,* administrative organs of government, development agencies, financial and credit institutions, distribution and marketing agencies, all being activated under an umbrella of political commitment and support. It is therefore naive to imagine that, in general, an educational institution can conduct this orchestration of inputs from so many and varied institutions.

It is this perspective that has guided ASTRA's main emphasis on the generation of technologies appropriate for rural development. Of course, the generation and diffusion of technologies are dialectically inter-linked — the problems of technology diffusion should condition the technologies which are generated, and the characteristics of the generated technologies should influence the detailed process of technology diffusion. Above all, the generation of technologies becomes a pointless endeavour, unless it is inspired by the vision of eventual diffusion.

ASTRA has, therefore, given serious consideration to the process of diffusion of its technologies. Four main mechanisms of technology dissemination are envisaged:

(1) micro-diffusion to the cluster of villages around the Ungra Extension Centre
(2) meso-diffusion through the Karnataka State Council for Science and Technology to the rural areas of Karnataka
(3) macro-diffusion through rural development organizations and agencies throughout the country and in other developing countries, and
(4) long-term diffusion through the establishment of an Institute course which produces a new breed of rural development technologists.

ASTRA's efforts towards the micro-diffusion of technologies in the cluster of villages around the Ungra Extension Centre are in the incipient stages. To safeguard against inappropriate technologies being transferred to the Ungra cluster, the technologies

generated on the Institute campus will be screened in several ways: (*a*) by consulting the local people prior, during and after the innovation process; (*b*) by scrutinizing the technologies with theoretical criteria of appropriateness, (*c*) by demonstrating these technologies on the Extension Centre. It is hoped that close interaction with the people will ensure appropriateness and acceptability of these technologies. This interaction has begun in the case of hand-pumps and housing, and will be extended to other projects.

The mechanism of meso-diffusion through the Karnataka State Council for Science and Technology is already in progress. A detailed description of this Council and a case-study of an ASTRA-KSCST interaction is given in other papers by the authors.

The macro-diffusion of technologies through rural development organizations and agencies must be based on effective communication of experiences and know-how. This communication may involve several channels — publications, visits, exchange of personnel, seminars and conferences All these channels are planned to be established, but it is too soon to say how effective ASTRA will be as a technology generation group to assist organizations and agencies more pre-occupied with technology diffusion and utilization.

From a long-term point of view, the most significant way in which an educational institution can contribute to the diffusion of development-oriented technologies is by training technologists who can be absorbed in the rural development agencies and advance the diffusion processes. With this in view, ASTRA is planning on a course on "Technology for Rural Development" to be run by the Institute in a couple of years. The expertise to give such a course must grow in an organic fashion, and this growth does not depend upon reading books but, on the real-life experience with ASTRA's projects on the campus and in the villages. The sequence which will be adopted is as follows: R&D → diffusion of technologies → growth of expertise → short-term courses → syllabus for 2-year course → 2-year course. When the products of such courses enter the development agencies, and begin to

organize the diffusion of technologies, the real multiplier effect of education will be observed.

The above discussion only serves to underline the fact that it is far too early to make a definitive judgement on ASTRA's contribution to the diffusion of technologies.

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SOCIO-ECONOMIC ASPECTS OF RURAL DEVELOPMENT

There are several organisations, in India, which are involved in managing and funding Rural Development activities. Institutions dealing with special aspects of management have been studying various social and economic features of rural development programmes by incorporating suitable management techniques. Several commercial banks have been giving grants and loans for rural development projects. In particular, the State Bank of India has recently established a large fund to be used exclusively for research in rural development technology.

In this section three papers are presented. The first paper deals with a description of the activities of the State Bank of India with regard to Rural Development, while the other two papers are presented by faculty members of the Indian Institute of Management. These papers deal with socio-economic aspects of rural development: habitat, employment and social change, and provide a pointer to the importance of these aspects of rural development.

ROLE OF THE STATE BANK OF INDIA IN RURAL DEVELOPMENT

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The State Bank of India has been playing a pioneering role in financing agricultural development in the country. Besides covering rural areas by extension of banking facilities with a network of 1,619 offices, (38 per cent of all our offices in the country), we have launched a few innovations in our lending programmes which can rightly be called credit-plus programmes. Financing of agriculture, in the true sense, by commercial banks, started only in 1968. Here again, the lack of experience in the initial 2–3 years of growth posed certain problems; but a quick stock-taking was done of the problems and the failures were used to guide us in programme formulation for the future with the result that the Bank's advances to agriculture have, during the 8 year period, increased seventeen-fold from Rs. 19 crores (1 crore = 10 millions) in 1968 to Rs. 330 crores in 1976.

Statistics, however impressive, would not fully indicate the extent of the contribution made by the Bank in the field of rural credit. Over the past eight years, the Bank has evolved its own approach to the problems of agricultural finance and rural development, in this country of small farmers, and devised a suitable organisational framework for the purpose. The Bank's approach in this area was not evolved on an 'a priori' basis but was the result of a process of experimentation. Initially, the Bank used to finance agriculture as a walk-in business. Farmers from any village in the area of operation of the branch would approach the bank for finance and their proposals would be entertained. This resulted in scattered lending and rendered supervision, guidance and extension work both difficult and expensive. Consequently, though the Bank's advances to agriculture increased rapidly in the initial years, there was no visible impact of bank-

lending on the area nor could the problem of weaker sections in agriculture be adequately tackled. The Bank has, over the years, evolved an intensive area approach which aims at integrated rural development in selected villages or areas. It would be my endeavour in this brief paper to outline the main features of the strategy which the Bank has evolved in the field of rural development.

Integrated rural development has different connotations for different people. In its most comprehensive sense it consists of the ambitious integrated rural development programmes proposed to be implemented by the Government of India in a few selected districts, following a special paper presented by the Union Finance Minister in March 1976 on "Strategy for Integrated Rural Development." Under these programmes, for the areas selected, a portfolio of well-defined schemes is being compiled. These will be costed and assigned to agencies — official, voluntary, scientific, educational, industrial, etc. — who are considered suitable for handling such tasks. A mere enumeration of the agencies that would be involved, is sufficiently indicative of the magnitude of the task and the degree of concentrated effort envisioned for the purpose. To put it a little differently, such a programme can be considered to be an amalgam of a number of sub-plans — a credit plan, a training plan, an education plan, a health plan, an employment plan and even a minimum needs plan. The role of any bank in such programmes can only be participative — there is no question of any credit-purveying agency either formulating or possessing the capacity to implement comprehensive programmes of this genre. Having conceded this, it is none the less true that the State Bank's efforts during the last eight years or so, taken together, add up to something more than a mere credit-programme — in the sense in which this term is normally understood. While making available the input of credit, the Bank has actively endeavoured to make sure that along with credit, certain other important pre-requisites for actual development and increase in productivity, are also made available. It is for this reason — and the point will be further elaborated in the succeeding paragraphs — that, I believe that while the State Bank's intensive area programme may not merit the description of an 'integrated rural development programme' of this type, it certainly has been a credit *plus* programme.

In shaping our intensive area programme, though overall development of agriculture was the major aim, the small farmers were considered to be the target group, for the simple reason that the small farmers constitute the largest number of agricultural producers, with low productivity per man-year. In view of the high priority accorded to increasing agricultural production and employment opportunities, a focus on small farmers was obviously inevitable. The State Bank's agricultural credit programme is based on one key premise — that for the success of a credit programme designed to benefit economically weaker sections, more than money is needed. Loans to small farmers would not in themselves lead to greater production, unless accompanied by improved technology. Here, we would like to pinpoint factors which must accompany the provision of credit, if the programme is to be termed a success:

(*a*) There must be an opportunity for small farmers to utilise the credit *profitably*. This means that areas selected for the credit programme must be such where the improved technology *can* be applied by the small farmers and the farmers are willing (or could be persuaded) to apply this technology. Provision of credit in areas with stagnant technology, can at best have a negligible impact.

(*b*) The improved technology must be backed up by *markets* that can supply the necessary inputs and absorb the output at prices remunerative to the small farmer-producer.

The above two requirements for the success of the small farmer credit programme may appear to be fairly straight-forward, but in actual practice are not as easy to ensure. The State Bank's contribution has been to devise a *system* specifically fashioned to enhance the productive impact of the credit extended to the farmers, and it is the coupling of this system with the credit programme that entitles the Bank to term its development-oriented, intensive area programmes as credit *plus* programmes. I would now like to devote a few paragraphs to the system evolved for the purpose of ensuring that the requirements for the success of the small farmer credit programme are met in areas where such programmes were introduced by the Bank.

Most of the All-India figures about the credit-gap in the agricultural sector, if interpreted carelessly, are apt to be misleading in one very important respect. An inference likely to be drawn all too easily is that there is a vast, unsatisfied demand for credit in the countryside and almost any centre or area can readily absorb a considerable amount of credit. Nothing can be farther from the truth. The point I would like to emphasise is that a successful credit programme cannot be administered just anywhere — the areas have to be carefully selected and the Bank has to satisfy itself that the conditions for the successful implementation of the programme are either present or that the necessary conditions can be created with the efforts of the Bank within a reasonable period of time. This area-selectivity becomes inevitable from another angle also. As I shall explain in greater detail elsewhere in the paper, the implementation of an intensive area programme, requiring as it does a constant and continuing effort on the part of the Bank to ensure that the conditions necessary for the success of the programme are present, pre-empts a considerable portion of the Bank's resources and energy and hence such programmes cannot be multiplied in a routine fashion. Let me now briefly run over the conditions that the Bank considers should be present or be capable of being created, in areas where we introduce our ambitious credit programmes.

In the first place, there should be a reasonable chance of the traditional technology being given up by the small farmers and their opting for the new productive techniques. Two considerations are relevant here — (i) the basic agronomic conditions should be such as can support the new technology, (ii) since the small farmers are often slower than large farmers to adopt new and more productive technologies, because of a greater risk-aversion and a lower level of awareness, no credit programme can really hope to succeed unless the Bank is prepared to do considerable extension work; it is not correct to place complete reliance on the State Government's extension machinery for this purpose. The above two considerations taken together have considerable operational significance for the Bank. We can afford to select only such areas which, while backward, possess the potential for a reasonably quick change-over to new tech-

nology and where the small farmers can be made receptive to the new technology within a reasonably short period of time.

In the second place, we must satisfy ourselves that a shortage of capital *is* or *would* be a constraint on adoption of new techniques by small farmers as a group when profitable new techniques are available and the farmers are willing to use them. In operational terms this means that there would either be no other credit-purveying agencies in the area or, if existing, they should be in no position to meet the estimated credit-needs.

In the third place, the Bank — acting singly or in collaboration with the official or semi-official agencies—should be in a position to ensure that the inputs needed to sustain the new technology would be made available at the right time and the additional output would be conveniently marketed by the small farmers at remunerative prices. This is of particular importance when allied farming activities — such as dairy, poultry, piggery, etc., — are sought to be encouraged, or even when the cultivation of special crops such as vegetables is sought to be popularised. It is here that anything going wrong is likely to seriously dampen the enthusiasm of the small farmer — and the re-kindling of interest may prove to be very difficult indeed. The Bank has thus to make doubly sure that it has not bitten off more than it can chew.

In the fourth place, in endeavouring to wean away the small farmers from the private money-lenders and over-coming their disinclination to deal with official institutions, the Bank has to reckon with the *plus* points of the informal private money lending. These are — timeliness, absence of red-tape because of security and documentation norms and flexibility in repayment. Unless suitable organisational machinery incorporating at least some of these features is devised, many of the credit-programmes would fail to make any significant headway.

The operational significance of the abovementioned factors as perceived by the State Bank, can now be stated. It was realised by us that (*a*) selection of suitable areas would require detailed surveys and hence expertise, (*b*) the in-depth assessment

of the development-potential of the identified areas and the practical formulation of bankable area-development schemes, also entails practical know-how and expertise, (*c*) for ensuring the requisite degree of extension effort to educate and motivate the small farmers, the timely supply of inputs needed for the new schemes, and for ensuring the ready marketability of the additional output — considerable interaction with the official agencies/departments is needed, (*d*) the constant monitoring of the schemes and the institution of corrective action at the right time, calls for specialised knowledge and unusual dedication on the part of Bank-staff, (*e*) the credit programmes of this type require efficient administration of credit — which would *inter-alia* consist of close supervision, follow-up and above-all *timeliness* in making the credit available to the small farmers.

The logic of an efficient intensive area programme thus dictated the creation of a specialised organisational setup for the purpose of purveying credit in the rural areas. It was obvious that our ordinary branches in the rural/semi-urban centres were in no position to meet the demands of a development-oriented programme. It was equally obvious that mere provision of new resources to the existing branches carrying on routine work, could not generate that single-minded drive which must necessarily accompany provision of credit, if such programmes were to succeed in the present-day conditions of Indian agriculture. It was in this context that the Bank's Agricultural Development Branches came to be established. This was, and still is, a unique experiment in the history of rural banking — no other commercial bank, whether in this country or abroad, has gone in for this type of experiment. The Agricultural Development Branches of the Bank commence with business-plans of 4–5 years, in the first instance. Within this period, anything between Rs. 1.00 to Rs. 1.50 crores, is planned to be disbursed in 100 to 125 villages that may form the ADB's area of operation. The bedrock of the business-plan is provided by a series of area-development schemes formulated with reference to the potential and local resources of the area. The progress of the schemes is reviewed at quarterly or six-monthly intervals, the assumptions on which the schemes were formulated are also periodically re-examined and operational inadequacies identified. The ADBs are equipped with adequate technical and

non-technical staff support. Whithin the last 5–6 years, the State Bank Group has established 255 ADBs over the length and breadth of the country. As at the end of December 1976, 720 area development schemes involving a financial outlay of Rs. 237 crores were prepared. Out of the 196 ADBs of the State Bank (excluding those opened by our Associate Banks), as many as 120 are in backward districts. Sixty-six per cent of the farmers financed by the ADBs belong to backward districts and 64 per cent of the credit has gone to these districts. Extension of credit at the ADBs is accompanied by extension work by the technical staff attached to these Branches, who guide the borrowers in adopting improved practices and inputs. This service is of great benefit, particularly to small farmers.

It is, of course, much too early to arrive at any definitive conclusion as regards the success or the failure of the Bank's rural credit programme. Indeed, there is at present no agreement on even the criteria to assess the success/failure of such programmes. In the foregoing paragraphs, I have dealt at length on the conditions required for an agricultural credit programme for small farmers to increase production and how the Bank has endeavoured to evolve a system which gives a reasonable chance to ensure the presence or creation of these conditions. We do feel that the Bank's credit programmes have led to an increase in agricultural production wherever these have been introduced. But the mere fact of there being increases in agricultural production does not, in all honesty, entitle us to term the programme as an unqualified success. A credit programme entails the incurring of certain costs — and in a successful programme the benefits must exceed the costs. Among the costs are administrative costs, supervision costs, cost of funds deployed, defaults and other social costs. The benefits are mainly the increases in production attributable to the programme, and the interest yield. While the social cost-benefit exercise is extremely difficult to carry out — in particular, because of the difficulties involved in estimating the precise quantum of increase in output resulting from credit provision per se — the financial costs and benefits to the lending agency are easier to estimate. Insofar as the Bank is concerned, our agricultural financing operations show a net financial loss. Our agricultural credit programmes are being subsidised — this is not

to say that a subsidy is undesirable in itself. Subsidies may well be justified provided the social benefits that flow to the society more than offset the social cost. There is a strong case for seeking to evolve systems of agricultural credit that could cut down the financial (as also social) costs of providing credit and the subsidy element, and if at all it be necessary, must not be allowed to assume dangerous proportions. It is in this context that the Bank has consistently advocated the financing of more and more primary agricultural credit societies by the commercial banks.

The paper will not be complete without a few observations based on our practical experience of administering the development-oriented intensive area programmes. In deciding upon the location of the ADBs, selection of areas to be developed and the formulation of area development schemes, the Bank has played the role of the *prime* agency or the sponsor-agency. Allied to this is the catalytic role played by the Bank in seeking to involve the Government agencies in creating the conditions necessary for the success of such programmes. This is an unusual reversal of roles — in general, the extension machinery of the Government sponsors development programmes with the credit agencies expected to suitably adjust their programmes. This role-reversal has led to interesting developments. Firstly, the Bank's initiative in the agricultural sector has necessitated the formulation of *bankable* and viable schemes. With the best of intentions, a non-financing development agency often omits to provide for details that are of importance to the bankers. Secondly, at the stages of formulation, implementation and evaluation of the area-development schemes, the broader objectives of the schemes are more likely to be kept in view if the Bank happens to be the prime agency. The credit-cycle has a closer affinity to the overall process of development than the narrow objectives which many official programmes end up trying to achieve. For instance, an SFDA (Small Farmers Development Agency) organisation's first and immediate concern is the quantum of subsidy released. The basic consideration of how much economic benefit has actually accrued to the small farmer — in terms of the increased output and income — tends to be submerged in the data pertaining to the subsidy-release. Similarly, in respect of many of the official schemes, the impact at the grass-roots level is not always sought

to be assessed. The Bank's stakes are heavier because the recycling of funds depends to a large extent on the successful implementation of the scheme. Thirdly, as the prime agency, the Bank has been generally quick to institute immediate corrective action, wherever operational handicaps are encountered in the implementation of the schemes. In the very nature of things, the credit-purveying agency is the first agency to receive signals of the operational problems encountered by an area-development scheme. Hence, the task of monitoring — when handled by the Bank — has always produced more constructive results, as compared to the official monitoring.

Apart from the intensive area programmes of agricultural financing, the broad features of which I have explained above, I would also like to bring to your notice the exercises in integrated area development which the State Bank Group is undertaking for its lead districts. Under the Lead Bank Scheme, the State Bank Group had been assigned the responsibility of developing the banking and credit structure in 89 districts of the country, to meet the needs of economic development of these districts. This number has now increased to 99, as a result of bifurcation of certain districts. The Bank has already identified suitable growth centres in these districts, where branches of commercial banks are being opened. Apart from identifying growth centres, the Bank has also prepared credit plans for the lead districts, consisting of bankable schemes for rapid growth of the major sector and expansion of the inter-linked activities in other sectors of the economy, so as to bring about integrated development of the districts. For the development of the agricultural sector, the district credit plans consist of three types of schemes: schemes for improvment of land, schemes for utilising land so improved for increased production and schemes to promote activities allied to agriculture.

With a view to assisting the small and marginal farmers, the district credit plans include schemes for financing allied agricultural activities like dairy, poultry farming, sheep rearing, etc. These activities help in making the agricultural operations of the small and marginal farmers viable and in providing subsidiary sources of living to the landless labourers. The credit plans

take into account the district development plans formulated by the Government agencies and link up the schemes of financing the production plans in the private sector to public sector outlays and schemes envisaged in the development plans. Such dovetailing of schemes in the development plan and the credit plan ensures that the infrastructure necessary for the successful implementation of the credit schemes is available and Government departments also have a partial responsibility for implementing the credit plan. Apart from schemes of Government departments, projects envisaged by other developmental agencies are taken into consideration when preparing the credit plans and supporting schemes based on the forward and backward linkages of these projects are also included in the credit plan.

Though the credit plans prepared by the Bank for its lead districts cannot be said to be as comprehensive as the integrated rural development programmes being prepared by the Government of India, they do provide a basis for joint action by the financial institutions and other developmental agencies operating in the district.

To sum up, through its intensive area approach to agricultural development and district credit plans, the State Bank of India has been playing an important role in planning and development of the rural areas of the country. The development problems of a country of the size of India are indeed complex. Evolution of appropriate technology and transfer of such technology to farflung farms and factories are a challenging task The Bank is assuming increasing responsibilities in development, in collaboration with other agencies operating at the grass-roots level. With increasing experience, we hope to make further refinements in our strategies, so that, as a premier banking institution, we continue to remain in the vanguard in the war against poverty.

INTEGRATED DEVELOPMENT FOR RURBAN REGIONS

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THE BASE

In recent times, the emphasis in the debate on development has shifted to rural regions; it was on urban regions in the earlier decades of planning. The main thrust of planning and development efforts over the past three decades had been directed on urban pockets. There is no doubt, generally speaking, that the developing countries, in their understandable eagerness to raise levels of living, have put too little emphasis on the planning and development of the rural areas where 80 per cent of the population (e.g., in India) live.

Most of the expenditure on development in India during the past three decades has been shared by larger cities with more than one lakh population. It is observed that the Calcutta Metropolitan Region has received benefits at the rate of nearly Rs. 200 per capita whereas urban people outside the metropolitan district, in West Bengal, have received benefits of the order of only Rs. 5 per capita. The investment per capita in the Bangalore District is Rs. 710 whereas the per capita investment in the rest of the districts of Karnataka is only about Rs. 140. The two examples cited above indicate the directions of development and expenditure in the past.

Further, it has been found that population growth in cities with population of 5–10 lakhs has been computed at 88 per cent during 1961–71. Thus, the larger cities appear to grow faster while the smaller ones are shrinking in size. Moreover, the overall picture indicates that the disparity in the development between urban and rural areas and within urban and rural areas themselves, are constantly on the increase. The inequalities in income and

disparities in the socio-economic infrastructure (including social and civic amenities) have widened so much that one is compelled to look back, as one does in failure, in order to take stock of the situation and find out how the objectives of development have been falsified in implementation. After three decades of development, two-thirds of our villages are yet to be electrified.

What we can be absolutely sure of is the fact that there has been a population shift from the smaller settlements to the larger settlements on the one side and from rural to urban communities on the other. These shifts are essentially due to the deliberate planning system chosen to accelerate the rate of industrialisation on the one hand, and to increase the rate of agricultural output on the other hand, with the objective of raising the rate of growth of our national economy and thereby raising the levels of living of our teeming millions. In the process, economic development and industrialisation have thus created two major problems for the society of today: the larger cities have so overgrown their capacity for enlargement that diseconomies have set in, together with a marked deterioration in the quality of the urban environment; the second problem today is the manifestation of the declining and negative growth trends in the rural areas and in the smaller settlements, thus weakening their economies.

In order to correct this disproportionate and disequilibrating urbanisation and the disparity in growth between the rural and urban areas, and within the urban settlements and rural settlements, the thrust of development should be brought to bear upon these areas where larger groups of population collect. It is in search of new alternatives and new options in planning, then, that we have turned today to the development of rural areas. Basically, the objectives of such development may be listed as:

(1) To distribute the benefits of development as widely as possible — both in terms of area and population
(2) To discourage the migration to urban areas and to prevent emigration from the rural and smaller settlements
(3) To make the low-order settlements more habitable
(4) To preserve and conserve the environment at the grass-roots level

(5) To modernise the rural areas by providing so-called 'urban' amenities and economies of scale in urban areas which depend on high densities of population
(6) To provide the basic infra-structure required for modernisation
(7) To augment the techno-economic viability of rural areas and to broadbase the development strategy over as many areas as possible
(8) Finally, to reduce the imbalance in growth and development between the regions.

Urban agglomerations have demonstrated their capacity to absorb additional investments of capital. Investment in industries require to be accompanied by certain amenities which are available today only in high order settlements like cities and metropolises. On the other hand, the rural areas start off with a handicap: they lack either an appropriate resource–base or the shared overhead investment that should be provided by a local authority. On the assumption that a resource-base can be built up in the rural areas, the question that must be considered is, at what levels can chosen rural areas absorb the resources injected into them? Are all the settlements in the rural areas to be treated on par or differently, based on merits? There are certain diseconomies peculiar to low-order settlements, to small sizes of population, which may not be socially, technically and economically viable for embarking on any modernisation or industrialisation.

It may be mentioned here that an amount of diseconomy has also crept into the high-order settlements, such as a metropolis, where the cost of infra-structure for development per capita has become inordinately high. It is therefore better to look for suitable levels in the rural economy where development can be induced and which can transmit the development impetus to settlements at a lower level. Therefore, this paper specifically seeks to identify critical areas which are capable of responding to development expenditure and are capable of absorbing appropriate technology. Identification of critical areas for development within the rural and urban areas as potential areas for planning so as to uplift the economy of low-order settlements and also to arrest the growth

of larger settlements, are of primary importance in today's socio-economic system. A case has been made out in this paper to end the rigid distinction now being made between urban and rural areas and for purposes of development in recognition of the uniform logic or pattern underlying the formation and growth of settlements. They are always dynamic, never static, and do change within a range of parameters. The variables, such as population, employment, infrastructure and decisions about location and economic activity, will cause changes in the growth of settlement patterns.

The prevailing disparities between the urban and rural areas provide a starting point for this discussion. An analysis of the settlements and population growth patterns can help in the identification of regions suitable for development, and it is the thesis of this paper that "rurban" regions qualify for development under this criterion. Finally, the paper discusses the suitability of the rurban regions as nodes for development and suggests a framework within which the strategy for the development of these areas can be attempted.

RURAL-URBAN DISPARITIES: AN OVERALL VIEW

India's population of 548 million (in 1971) was distributed over 97 million households. The changes in the rural and urban populations and the growth in the number of households over the years[1] are noted in Table 1.

TABLE 1
Population and Households in 1951, 1961 & 1971

(*millions*)

Year	Population			Households		
	Rural	Urban	Total	Rural	Urban	Total
1951	298.5	62.4	360.9	60.6	12.8	73.4
1961	360.1	79.1	439.2	68.6	14.9	83.5
1971	438.9	109.0	547.9	78.0	19.1	97.1

Source: Computed from census data.

The size of the average household has increased from 4.9 persons in 1951 to 5.2 persons in 1952 and 5.7 persons in 1971 and the variation in this figure for rural and urban areas has been marginal. This trend, incidentally, rebuts the general belief that the formation of nuclear families, following the gradual breaking up of joint and extended families which would normally restrict the household size, is on the increase. Moreover, the ratio of households to the housing stock in rural and urban areas remains more or less the same. The ratio between the numbers of rural and urban households as also that between the numbers of rural and urban houses was 84:16 in 1951, 82:18 in 1961 and 80:20 in 1971. It is evident that this ratio is consistently changing with time, with the urban fraction increasing.

INEQUALITIES IN INCOME

The urban and rural households have been grouped into the following size-classes on the basis of their monthly incomes:

(i) below Rs. 100
(ii) Rs. 101–200
(iii) Rs. 201–500
(iv) Rs. 501–1,000 and
(v) above Rs. 1,000

Only cash (money) incomes have been taken into account in this paper. The data presented may not conform to the officially published estimates prepared by the Central Statistical Organisation (CSO), since these estimates include income accruing in kind and/or from other sources. From Table 2, the average household size is observed to increase with the income of the family.

Again, there are glaring income disparities between the urban and the rural households. About two-thirds of the urban households are concentrated in the middle-income group (Rs. 101–500), and 43 per cent have incomes exceeding Rs. 200 per month. About one half of the rural households fell in the low-income group (below Rs. 100), and 85 per cent have incomes below Rs. 200. The average household income in the urban and the rural areas is Rs. 3,660 and Rs. 1,850 per annum respectively. A picture of

urban affluence contrasted with rural poverty emerges from the above analysis.

TABLE 2
Distribution of Households by Income

(*Percentages*)

Monthly Income (Rs.)	Percentage of Households			Average Household Size		
	Urban	Rural	Total	Urban	Rural	Total
Below 100	22.5	51.9	46.3	4.4	4.7	4.7
101–200	35.0	33.3	33.6	5.5	6.2	6.1
201–500	29.6	11.9	15.3	6.4	7.4	7.0
501–1,000	9.1	2.3	3.6	7.0	8.7	8.0
Above 1,000	3.8	0.6	1.2	7.5	9.2	8.3
TOTAL	100	100	100	5.7	5.7	5.7

Source: Reference (1)

DISPARITIES IN HOUSING AND ENVIRONMENT

Table 3 gives the distribution of households according to income and the number of rooms in the tenements, in both urban and rural areas.

Standards in regard to the number of rooms available in a house vary in the case of urban and rural households. About 75 per cent of those rural households which have one-room accommodation, belong to the low-income group; the corresponding figure for the urban households is 42 per cent. In the income group Rs. 101–200, one-room or two-room houses are occupied by 64 per cent of the urban households as compared to 49 per cent of the rural households. In the Rs. 201–500 income group, about

58 per cent of the urban households, as against 72 per cent of the rural households, live in three or more rooms.

The concentration of a relatively high percentage of the low-income households in three or four rooms in rural areas may be attributed either to larger ancestral properties, or a higher ownership rate in housing (95 per cent). Migration from this low-income group to urban areas may be yet another contributing factor, but this aspect has not been studied in this paper.

Table 4 gives the distribution of households by income and by amenities available in the houses, in the urban and rural areas. In the income group "below Rs. 100", about 77 per cent of the urban house-holds, as compared to 91 per cent of the rural households, and in the income group Rs. 101–200, 59 per cent of the urban households, as compared to 86 per cent of the rural households, are without amenities. As is to be expected, a much higher proportion of the higher-income group both in the urban (94 per-cent) and rural (59 per cent) households dispose of houses provided with these amenities. However, amenities available to the urban households in the middle-income group in the urban areas correspond with the level of amenities enjoyed by the highest-income group in the rural areas. Though 80 per cent of the total households are concentrated in rural India, only 15 per cent of their homes enjoy these amenities. On the contrary, more than one-half of the urban households, though they account for only one-fifth of the total. inhabit houses which are furnished with these amenities.

It is observed that less than 12 per cent of the households in India live in houses built with *pucca* roofing of concrete, asbestos, galvanized iron sheets, etc. Tiled and thatched roof houses provide dwellings for 76 per cent of the households. The remaining 12 per cent of the households live under *kachcha* roofing. Almost roughly equal proportions of the urban and rural households live in Type B houses, and this proportion has changed only slighly during the past decade. The urban and rural households living in Type A and Type C houses are more or less inversely proportionate[1]. Thereby, it is felt, the disparities between urban and rural life-styles are widening fast. This calls for a change in the total

TABLE 3

Distribution of Households by Income and Number of Rooms

(*Percentages*)

Monthly Income (Rs.)	One Room		Two Rooms		Three Rooms		Four Rooms		Five or more Rooms	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Below 100	41.7	74.8	25.0	58.5	14.6	41.1	9.8	33.1	5.5	22.2
101–200	38.9	21.0	43.0	35.5	34.3	40.4	26.9	42.8	18.8	36.9
201–500	17.5	3.9	27.4	7.1	38.5	15.7	38.8	20.3	34.9	27.8
501–1,000	1.6	0.3	3.9	0.7	10.2	2.2	17.7	3.2	25.0	10.3
Above 1,000	0.3	—	0.7	0.2	2.4	0.6	6.8	0.6	15.8	2.8
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Percent to total households	24.3	24.1	30.2	33.7	20.3	19.1	11.1	11.3	14.1	11.8

Source: Reference (1)

TABLE 4

Distribution of Households by Amenities, Tenure and Roofing Material

(*Percentages*)

Monthly Income (Rs.)		Exclusive Amenities		Tenure		Roofing material			
		With	Without	Owned	Rented	Type A		Type B	Type C
						(i)	(ii)		
Below 100	Urban	23.0	77.0	58.3	41.7	12.0	13.0	40.4	34.5
	Rural	9.4	90.6	94.9	5.1	2.8	5.5	34.5	43.3
101–200	Urban	41.1	58.9	50.2	49.6	23.4	16.3	43.9	16.4
	Rural	14.3	85.7	95.0	5.0	6.5	7.3	42.4	43.3
201–500	Urban	54.6	45.4	46.2	53.8	44.3	23.9	35.2	6.6
	Rural	32.9	67.1	99.2	0.8	12.9	7.7	49.3	30.1
501–1,000	Urban	85.3	14.7	49.3	50.7	65.3	9.2	23.0	2.5
	Rural	52.2	47.8	96.6	3.4	23.5	15.1	44.8	16.6
Above 1,000	Urban	94.0	6.0	56.3	43.7	78.1	8.5	12.3	1.1
	Rural	59.2	40.8	93.3	6.7	36.6	11.5	41.0	10.9
TOTAL	Urban	50.0	50.0	50.9	49.1	32.9	13.9	37.5	15.7
	Rural	15.0	85.0	95.4	4.6	5.9	6.7	39.2	48.2

Source: Reference (1)

outlook and a rational and unbiased approach to the developmental problems of rural areas.

HABITAT AND POPULATION

As per the 1971 census, the 548 million people of India were distributed over 579,052 settlements; of which 575,933 settlements were designated rural with a population of 439 million. In the urban areas, 3,119 settlements accounted for a population of 109 million. The rural settlements are classed into seven groups and the urban settlements categorised into six, based on the size of their population.

The population distribution or density per acre shows a high correlation with the productive capacity of the land, which in turn determines the land values and the mode of land use. If land use is taken as the determinant, the formation and location of settlements are regarded as variables. The facility and convenience in the organisation of a settlement's internal economy, in the implementation of its social and economic plans and in conducting external transactions with other communities are all a function and consequence of the development of a region, and the way that plans to this end are manipulated to achieve these objectives. For every economic activity, every amenity, every facility and every service, there is an appropriate population threshold. Thus, the population size of a settlement, in turn, is a factor in determining the infrastructure it can afford. The growth pattern of settlements and the effect of changes in the population in each of these village-classes over the past two decades are described in Table 5.

The two lower orders of settlements, *i.e.*, the settlements of sizes less than 200 and 200–499, have shown marked tendency to decline in numbers; their populations too have declined. The growth factor during 1961–1971 is very high for the two higher orders of rural settlements in the size class 5,000–9,999 as well as in the 10,000 and above class. Two-fifths of the rural population lives in settlements which have a population of less than 1,000. More than a third of the rural population resides in settlements

TABLE 5

Number of Villages and Population in 1961 and 1971 by class of Villages

Class of Villages	Year				Decade growth Factor	
	1961		1971			
	Villages	Population (millions)	Villages	Population (millions)	Villages	Population
1. Less than 200	178,451	17.82	150,072	15.25	0.8	0.8
2. 200–499	173,572	57.66	168,561	56.63	0.9	1.0
3. 500–999	119,167	83.92	132,990	94.41	1.1	1.1
4. 1,000–1,999	65,383	89.58	81,973	113.16	1.2	1.3
5. 2,000–4,999	26,565	76.69	36,005	104.55	1.4	1.4
6. 5,000–9,999	3,421	22.34	4,974	32.72	1.4	1.4
7. 10,000 and above	776	12.29	1,358	22.33	1.7	1.8
TOTAL	567,335	360.30	575,933	439.05	1.0	1.2

Source: Computed from Census data

	Decade Growth factor of population 1961–71
India	1.3
Rural	1.2
Urban	1.4

with populations between 2,000 and 10,000. It has also been observed that the growth rate of populations in settlements above 1,000 size exceeds the national average for the period between 1961 and 1971. Thus, the settlements fall into three different categories according to the growth rates of their population. The first category has a negative growth rate (*i.e.*, the population actually declined), the second category which shows positive growth but at a rate less than the average population growth rate for the country as a whole, and the third category where the growth rate has outstripped the national growth rate of population.

The percentage of villages and population by classes of villages for 1951, 1961 and 1971 are described in Table 6. The coefficient of change between 1951 and 1971 indicates that the population increase was less than one in the three lowest-order village classes, *i.e.*, less than 200, 200–499 and 500–999.

The concentration of the rural population increased with the increase of size of the settlement upto size class 2,000, whereas the concentration of the population declined with the increase of settlements between the size classes 2,000 to 10,000 (Fig. 1).

The Figure shows that the apex, *i.e.*, highest concentration of population in any village class, is slowly shifting from the smaller to the higher village class. In 1951, the apex was located in the 500–999 population class, whereas by 1961 it had shifted to the next village class, *i.e.*, 1,000–1,999. In 1971, the concentration of population in the same village class had increased to 26 per cent of the rural population from the corresponding figure of 25 per cent in 1961. It is also observed that the percentage of the population in the village class 2,000–4,999 constituted about 24 per cent of the total rural population in 1971, which was almost equal to the value at the apex village class, 1,000–1,999, in 1961. Moreover, the concentration of population in all the village classes above size 2,000 registered an increase between 1951 and 1971 and all the village classes below 1,000, a decrease in the percentage of population concentration. Thus, the trend confirms the direct observation that the concentration is increasing in the larger village settlements.

TABLE 6

Percentage of Villages and Population by class of Villages in 1951, 1961 and 1971

Class of villages	Year			Growth factor between 1951 and 1971
	1951	1961	1971	
	(Percentage)			
1. *Less than* 200				
(*a*) Villages	33.35	31.45	26.06	0.78
(*b*) Population	5.87	4.95	3.47	0.59
2. 200 *to* 499				
(*a*) Villages	34.91	30.60	29.26	0.84
(*b*) Population	20.64	16.00	12.90	0.62
3. 500 *to* 999				
(*a*) Villages	18.48	21.00	23.09	1.23
(*b*) Population	24.68	23.29	21.50	0.87
4. 1,000 *to* 1,999				
(*a*) Villages	9.28	11.53	14.23	1.53
(*b*) Population	24.08	24.87	25.77	1.07
5. 2,000 *to* 4,999				
(*a*) Villages	3.59	4.68	6.25	1.74
(*b*) Population	19.44	21.28	23.82	1.23
6. 5,000 *to* 9,999				
(*a*) Villages	0.35	0.60	0.86	2.45
(*b*) Population	4.21	6.20	7.45	1.76
7. 10,000 *and above*				
(*a*) Villages	0.04	0.14	0.25	6.00
(*b*) Population	1.08	3.41	5.09	4.70
TOTAL				
(*a*) Villages	100.00	100.00	100.00	
(*b*) Population	100.00	100.00	100.00	

Source: Computed from census data

This trend of population growth in rural settlements is different from that found in the case of urban settlements. The concentration of urban population of the town, and therefore its size is measured by the former. The concentration increase is gradual between the size class 5,000 settlements and the size class 49,999. A sharp increase is discernible in population concentrations of towns with more than one lakh of population (Fig. 1). The towns of size classes 50,000 and 99,999 behave rather differently from the other towns in the urban group. It is difficult to identify the reasons for this, at this juncture — such identification may need further investigation. But, on the whole, it can be asserted that the concentration increases in the town groups in the urban areas have more or less followed a linear trend.

The growth rates of population in class 4, class 5 and class 6 towns (settlements with the population sizes between 5000 and 20,000) fell short of the overall growth rate for India between 1961 and 1971, whereas the class 3 towns (which have a population of more than 20,000) have exceeded the national average. It can be inferred from the foregoing that these classes of towns too have not registered any industrial growth. This, of course, is based on an epiphenomenal correlation or concentration between excesses of urban population and industrialisation. For the purpose of the study, industrialisation is treated as different from mechanisation. Moreover, these three town groups, *i.e.,* classes 4, 5 and 6, have shown declining trends in population concentration. These growth patterns in the urban towns have exemplified three rates of urban growth, *i.e.,*

(1) The towns whose populations have grown at rates lower than the average national growth rate
(2) The towns with growth rates higher than the national average
(3) The towns which have shown very high growth rates of population.

The decisions on development planning have to be based on:
(1) A full understanding of the facts relating to population and settlement growth patterns

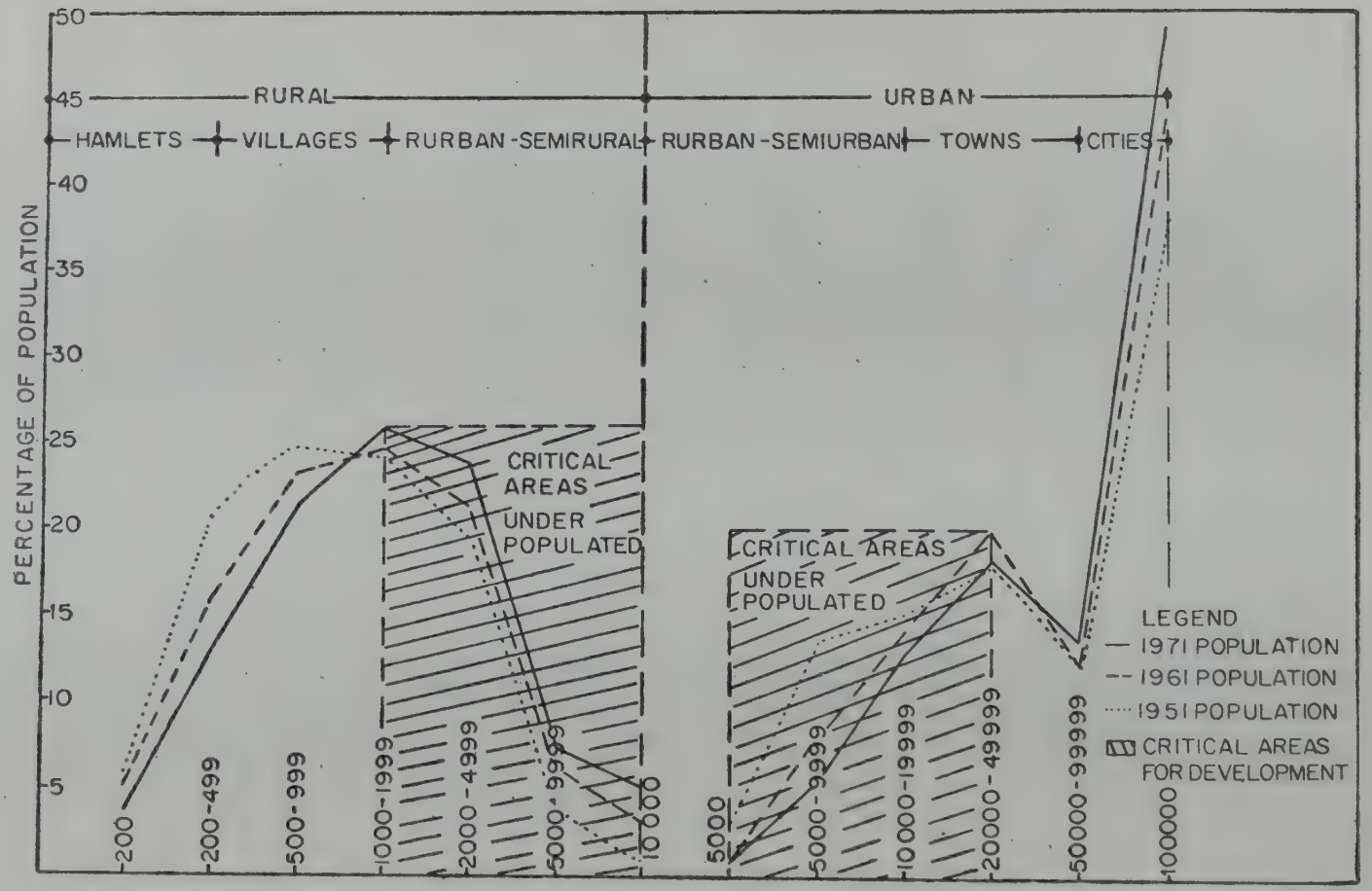

Fig. 1. Emergence of rurban centres

(2) Ways and means to reduce the imbalances in growth (is balanced growth feasible?)

(3) Fair distribution of development benefits to as many people as possible (can there be an absolutely equal distribution?)

(4) A chosen alternative between dispersal and consolidation of rural population or between a wide base and concentrated, highly urbanised centres for growth, or between a mixture of dispersal and consolidation — so as to stop the declining trend in smaller rural areas and rapidly increasing trend in larger urban areas

(5) Selection between industrialisation with less mechanisation, with low technology and industrialisation with high mechanisation and high technology

(6) The other socio-economic factors which are linked with the infrastructure and resource-base for development.

All these factors could not be analysed in this paper in detail, due to lack of data. However, based on an analysis of existing information, critical areas for development in the array of settlements are identified in the subsequent sections, followed by the presentation of a strategy for development.

EMERGENCE OF RURBAN REGIONS

At this stage it is necessary to correlate and to consider the dynamics of population growth among settlements in the urban and rural areas. In the rural areas, some village classes have shown a tendency towards urbanisation while certain towns or urban settlements have not been able to retain their populations.

The two larger classes of rural settlements have shown a declining curve and have not exhibited the normal linear trend in the concentration of population by class of villages, and have stood separately from the other rural and urban settlements. There may be a few reasons for this abnormal behaviour, which can be assessed by a thorough study of the physical and socio-economic structure of these settlements. One major factor that

we can attribute this irregular occurrence to, is the strong 'pull' created or established by larger urban settlements. Similarly, the deviation from the normal linear trend occurring in the larger urban classes of settlements, can be explained by the same phenomenon — the very strong pull created by cities with more than one lakh population. The areas which show deviations from normal trends in the growth, in the rural settlements classes as well as the growth-affected areas in the urban settlement classes, are identified as 'critical areas for development'.

By and large, the migrant populations have left the smaller towns and villages for progressively larger settlements. Development effort directed specifically at these areas — critical areas — will strengthen the structure of these settlements and enable them to hold not only the existing population but also attract emigrant population from the lower order of rural settlements. This may effectively control the set flow of population not only from rural to urban areas but also from smaller settlements to larger settlements. Furthermore, these settlements do not exclusively belong to either rural or urban areas. As such these may possess or develop capabilities for absorbing investments in the social and the industrial sectors. As noted earlier, the infrastructural cost is uneconomically high in the high-order urban settlements but on the other hand, the resource-base and infrastructure in the low-order settlements are such as to make these immediately viable for investments. The alternative is to choose an appropriate array of settlements so as to make them viable units. For example, amenities like a high school or a hospital or flour mill, etc., would not be viable in the settlements with population of 200 or even 500. Furthermore, two-thirds of the villages are not electrified and this may add to the difficulties of introducing modernisation into these villages immediately.

The basic question now is, how to conceptually regroup settlements so that they have the capacity to digest magnitudes of investment that are being contemplated under, say, the fifth and sixth 5-year plans of the Government of India. A discussion on the critical areas for development under the array of settlements based on their structure in the total settlement system has

been considered. The past two decades of changes in the growth of population related to class of settlements have been superimposed on the critical area concept, in order to regroup the settlements to suit the objectives set forth. With this end in view, the rural settlements are regrouped under three categories, namely, hamlets, villages and quasi-rural-rurban areas.

Similarly, the towns in the urban areas may be grouped under three broad categories: Quasi-urban — "rurban" areas, towns and cities.

The criteria applied for regrouping settlements to identify the areas which can be developed within the critical areas are:

A. *Criteria used for regrouping of rural settlements:*

(1) Settlements which have shown negative growth or less than 1.0 growth factor are grouped under *"hamlets"*

(2) Settlements which have shown positive growth (*i.e.,* more than 1.0) and lesser growth than of urban population growth (*i.e.,* less than 1.4) are grouped under "*villages*".

(3) Settlements which have shown growth rate equal to or higher than the urban population growth rate are grouped under *"rurbans: quasi-rural"*

B. *Criteria used for regrouping of urban settlements:*

(1) Settlements which have shown growth rate equal to or less than either rural or national population growth rates (*i.e.,* less than 1.2) are grouped under *"rurbans: quasi-urban"*

(2) The rest of the urban settlements are divided into two groups: towns and cities. Settlements with more than one lakh population are called *"cities"*.

The regrouping of settlements under this classification has been shown in Table 7. The population and number of towns under each category is also listed in the table.

TABLE 7

Regrouping of Settlements

	Rural			Urban		
	Hamlets	Villages	Rurban: Semi-rural	Rurban: Semi-urban	Towns	Cities
Class of settlements	Below 200	500–999	2,000–4,999	Below 5,000	20,000–49,999	1,00,000 and
Class of settlements	200–499	1,000–1,999	5,000–9,999 10,000 and above	5,000–9,999 10,000–19,999	50,000–99,999	and above
Number of settlements	315,633	214,963	42,337	2,097	871	151
Population (million)	71.88	312.12	55.05	21.05	34.66	53.38
Percentage of rural/ urban population	16.37	47.28	36.35	19.30	31.77	48.93
Percentage of total population	13.11	37.87	29.12	3.84	6.32	9.74

Source: Computed from census data.

ABOUT THE TERM 'RURBAN'

The term is intended to connote a blend of the rural and the urban. The quasi-rural rurban areas are different from the villages and settlements. Likewise, these rurban settlements are distinctly quasi-urban and perceptibly different from other urban town groups. Rurban settlements would then blend with both rural and urban conglomerations.

The role of rurban centres would be different from that of the rurban regions for the simple reason that the urban regions could include the settlements which might not be rurban. Any development in a rurban centre will have its impact on the lower-order settlements that it includes. The thesis of this paper is that the rurban centres should be considered as the focus of development to start with. That would be the surest strategy to ensure that the "beneficiation" of the village economy is consummated. Plans for the development of individual rurban centres should be incorporated in a structural development plan embracing all urban regions.

A FRAMEWORK FOR INTEGRATED DEVELOPMENT OF RURBAN CENTRES

The settlements at the level of the city and the metropolis have overgrown their structural and service capacities. The capacity utilisation of public utilities or infra-structure, such as water-supply, sewerage, drainage, transportation, housing, etc., for these settlements in the cities and metropolis have become unequal to the task of meeting the swollen demand. Inordinate population growth, a two-tier price system and weakened control of local authorities have rendered ineffective the provision of facilities by public authorities and market prices alike. Absence of town planning has created an aggrieved public, in specific instances. The result of all this has been that the city's structure and services have come under heavy strain. An important consequence has been the abnormal increase in development cost.

On the other hand, the capacity for services in the rurban centres is under-utilised. The absorption capacity for investment

in the rurban zone is very high and is evidenced by the valley (Fig. 1) formed between the lowest and highest values for population concentrations of settlements. The rurban zone offers some unique advantages. It offers great potential and demand for intermediate technology. Medium and light industries for the production of consumption foods which do not have as high a priority as, say, core industries and which are more employment-intensive and based on semi-skilled labour, could be located in rurban regions.

Households in the constituent villages and hamlets could retain agriculture or farming as their primary activity, and also have rurban industries. The quasi-urban, rurban regions should look for alternative growth patterns involving industrialisation (through ancillary industries and captive outputs or complementary industrialisation) and share their growth with larger city settlements and metropolises. The basic idea underlying this approach seeks to ensure the potential of the rurban regions as areas for growth and development in the future, in order to achieve balanced growth; more modestly it will reduce the imbalance of growth that has occurred during the past three decades. By improving the quality of life in the rurban zone, it would be possible to ameliorate the lot of the poor, whose numbers are significant in these areas and shore up demand in these areas. Any substantial upliftment will be possible only through the necessary levels of investment which rurban regions can absorb. The integrated development planned for rurban regions could attenuate the disparities between rural and urban areas. Last but not least is the belief implicit in this thesis that the technical and economic development taking place in the rurban centres will filter down into the next order of settlements, namely the outlying villages. Any development strategy for the planned and integrated development of these areas will have to be a phased operation, carried through in stages. A framework for such an operation is discussed below:

The following six broad stages can be identified for such an integrated development plan. These stages are:

(1) Assigned functions; *i.e.,* the role of settlements based on their structure

(2) Desired hierarchical facilities and amenities which will involve decisions on the type and size of facilities in relation to the size of the settlements

(3) Policies and the location of hierarchical functions — which will endow the rurban growth centres or regions with the necessary growth facilities and enable them to absorb the levels of investment contemplated under the plan

(4) In the plan for modernisation based on socio-economic viability of individual units — the threshold of population and economic and social viability for modernisation through industrialisation, should all be taken into account.

(5) Reorganisation or regrouping of settlements so that they have an optimum resource-base for better capacity utilisation, identification of area capabilities of development, and enhanced rate of absorption of additional population per unit of resource available as investment is stepped up.

(6) Plan elements for integrated development:

(*a*) the rurban regions' socio-economic setting
(*b*) communications in the rurban regions
(*c*) appropriate science and technology for the rurban centres
(*d*) the modernisation of industrialisation in rurban centres
(*e*) infra-structural development, public health in general including housing, environment, education, water-supply, sanitation and sewerage services, industry, transportation, communication, etc.,
(*f*) a development plan for the outlying villages and hamlets.

The end-product of the exercise will be, more or less, the preparation of an integrated development plan for rurban regions which not only includes the rurban centres but also the villages. The emphasis would be on identifying the aggregated capacities and capabilities of the settlements for development and for absorption of investment. The diseconomies that exist in the high-order settlements and lack of scope for viable development of low-order settlements have emphasised the need for alternative growth areas

for development. The dynamics of population growth of the settlements show that in a developing country like India where 80 per cent of the people reside in the rural areas should have no choice other than taking the development programme to the doors of settlements that are ready for it. It is hoped that this paper has established that the optimum level for development is the rurban regions, to start off with. The rurban regions are intermediate zones which are, in the present context, more amenable to development than either the rural or urban zones. Any improvement of the infra-structure in these intermediate zones will not only show better achievements and overall results but also provide and preserve the environment and the ecology of the country in critical areas.

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EMPLOYMENT, RURAL DEVELOPMENT AND SOCIAL CHANGES: SOME ISSUES

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INTRODUCTION

It is necessary to specify at the outset the objectives of this paper.

We plan to set down in brief, as a refresher, the major propositions of theory upon which current policies of development are apparently based. After this is done, we shall explore the avenues by which we may address ourselves to the theme of this section of the Seminar: the issue of employment for the development of rural areas.

Two other prefacing remarks should be in order. First, because the paper does not have an appendage of a bibliography, it is not to mean that the material is all original. Most of the ideas assembled here can be supported either by one or two standard references or by a researcher's list of a baker's dozen. Our attempt has been primarily that of synthesis among ideas, and towards a meaningful gestalt. Secondly, we have taken the liberty of altering the title of the paper (The original title towards which this paper was to be written was: Self Employment for Rural Areas). This needs an explanation too. It does not mean that the authors have any distaste for self employment in rural areas. The change is meant merely to indicate that we would prefer to examine various patterns of employment for their relevance and fit within conceived objectives of development, rather than on any one pattern exclusively; for in one socio-economic context it is possible for self employment to lead to self sufficiency in individuals and groups, and in another context, self employment may be employed quite effectively to induce a crippling dependence among them. Thus, self employment is not a virtue in itself and

it need not be equated with other concepts (and sentiments) such as self direction and self sufficiency out of context.

We felt that it might not be out of place in a seminar like this for us to retreat for a moment from all the experiences of developmental efforts in the country and to look for some conceptual framework or frameworks within which those experiences might be better understood.

LESSONS FROM THEORY

The major theoretical propositions that constitute the foundation of most policies of employment, growth and development may be briefly stated as follows:

(1) The modern epoch (say, the last two hundred years) has been a period of dramatically increasing growth rates in most aspects of individual and social life, such as life expectancy, levels of nutrition, quality of life (as represented by such indices of material comfort as clothing, shelter, work conditions and opportunities), communications, per capita income, level of population, number of schools, hospitals, and so on.

(2) What has made the modern epoch so dramatically different from earlier periods in history has been the systematic application of the principles of science to the problems of production (particularly in the now "advanced" societies). All this has resulted in (and from) a deeper understanding of various natural forces and has resulted in man's increasing ability to predict the behaviour of and to control, to an ever larger extent, the human and social environment. From this has emerged the modern, historical force which today is called "technology".

(3) A major factor that made this technological progress possible was a change in man's view of the world and of his own role within it. Such a change (for example, the change from faith in a somewhat benevolent God to man's ability in improving his lot by the use of his reason, by logic and experiment) was essential for the "technological revolution". However, this technological revolution" also hastened in turn, the changes in

man's world view. These changes include views on religion and technology as well as on social relationships: how one person is related to another. From the serf-lord relationship, society progressed to the free market, in which a man was free to take a job of his choice at a wage determined by the market. Such changes were a long time in the making. Their flowering before the Industrial Revolution seems to have been an essential condition for it. Thus the technological progress of the last two hundred years was made possible by a specific cultural milieu such as that which pervades Europe, the countries settled in by Europeans, and — as a remarkable exception — Japan.

(4) These are obvious propositions and we need only remind ourselves of the pioneering work of scholars like Colin Clark, Simon Kuznets, Karl Polanyi, Ralph Tawney and others to realize how little there is that is now original in our repetition of these.

There has also been a great deal of work, particularly after the second world war, that is pertinent to this discussion. Some of these propositions may be encapsulated as follows:

(5) Technological progress is a process with specific features and is not merely increases in output. Some of the features of this process are:

(*a*) The absolute increase in levels of agricultural output was accompanied by the relative decline in the share in national income of the agricultural sector.

(*b*) This increase in agricultural output occurred with rural people emigrating in large numbers to cities in search of employment in the newly growing industries. This makes clear that product (per man and/or acre) was increasing. It also means that there was a gradual increase in capital used in agriculture *via*, for example, modern fertilisers, machines, etc.

The very definition of productivity has emerged from this historical phenomenon.

(*c*) There was a rapid growth of all types of industry. The increases in agricultural output maintained not only the

slowly growing industrial labour force, but also provided the raw materials for many early industries (such as textiles, wool, tea). This growth of industry is an important element in the changing world view of this time.

Along with the new world view, a new life style evolved that emphasized the new phenomenon — industrialization.

(*d*) To support such industrialization, savings and investments, as represented by the proportions of capital formation in national income, reached great heights. All this was by and large the end product of changes that had been occurring in Europe through the middle ages. The changes matured into what may be called the market system, and historical processors of it would be, for example, the Hanseatic League and the Italian Merchant Bankers.

(*e*) Another important fact was the discovery of America — the 'new world'. Europe did not feel the pressure of increasing population, as emigration occurred on a large scale. Further, these people were of European stock, and over the years, this common background permitted useful relations to develop easily between the 'new' and 'old' worlds. These relations pertained mainly to the new resources of the American Continent.

(*f*) Related to the above, but not quite dependent on it, was the growth of colonialism in which huge areas of the world came under European hegomony. Thus, not only were the raw materials and resources that were available to the mother countries of Europe far in excess of what could be mobilized on the basis of their own savings, but the political control of other societies led to an international division of labour that, in the end, completely suited the needs of imperial Britain. An example is the "triangular trade" in slaves from Africa to Britain, in sugar and cotton (mainly) from the 'new world' to Britain, and processed commodities from Britain to the captive markets of the colonies. Without this, the spectacular growth of markets that supported and encouraged the technological revolution would have been impossible.

However, the effect of this very growth of Imperial Markets on the internal structure of the colonies is only now beginning to be studied.

(6) The technological progress of the early days came primarily from craftsmen and mechanics. Their inventions and innovations demanded theoretical explanation and spurred scientific endeavour onwards. This again is an aspect of the changing world view mentioned earlier. For example, the steam engine could not be explained in terms of the existing principles of physics, and the ensuing conundrums led to breakthroughs in the theory of heat.

(7) Later however, scientific endeavour was deliberately harnessed to the needs of industry and led to technological innovation. In response to specific industrial (or some societal) needs, scientific research and developmental efforts were programmed to certain precise ends. Such programming has shown spectacular results: the Manhattan project resulted in the atomic bomb; the Apollo project, utilizing knowledge already gained, and making advances where needed, put a man on the moon in ten years. In another dimension, General Motors, largely as a result of its strength in R&D, is today the world's largest producer of not only cars but many other products. The significant feature of such research is that it requires large investments of money.

Science and technology, therefore are no longer "neutral", and now reflect the priorities of those who have money or, more generally, a command over resources. They are now shaped and directed by prevailing social values and priorities.

(8) An important point that is beginning to get recognition only recently is one that (among others) Habbakkak made many years ago. Not only was science and technology put under the harness of Industry, but such a harness was put on it in the context of the specific problems that confronted Industry in specific countries. As a result, of all the possible options that were theoretically available, attention was diverted to only those that met certain specifications. These specifications pertained to cost con-

siderations in the production process to market conditions with respect to sale and final profitability. The first of these, in the final analysis, has to do with the endowment of natural resources in a particular country (It is necessary to stress that this is the case in the *final* analysis, because what usually comes into cost calculation is relative prices. Relative prices reflect the relative scarcities of resources at a given level of technology in the mother country, but not necessarily in its colony or satellite-country). The second, once again, derives from the prevailing world view, and pertains to the implicit values expressed as social priorities. Such priority or revealed preference depends upon the distribution of income and wealth (and finally upon the pattern of ownership of resources) in the society where industry is a major factor in the economy.

Thus in a society such as the United States, a great deal of research is geared towards labour-saving or capital-intensive (and till recently, energy-intensive) techniques of production. So much for the bias of research. The focus of such research is usually in commodities that enjoy a mass market or have the potentialities of a mass market. An excellent example, as narrated by Alfred Sloan, is the automobile in the U.S.A.

It is now also beginning to be accepted that the high rates of growth of various facets of the rich economies have been accompanied by (and have as often led to) some highly undesirable consequences. Examples of consequences are pollution, over-crowding, increasing rates of crime, suicide, juvenile delinquency and the like. These are consequences within the rich countries themselves. Geographically distinct from them, we have the emergence of a new historical category: the under-developed country. This is a unique historical category, and its analysis requires fresh perspectives and tools.

If we put these facts and findings together in the perspective provided by General Systems Theory, it seems likely that the high rates of growth of various factors along different scales and dimensions have led to a situation in which the survival of the social system depends upon a qualitative change in its structure.

Such a qualitative change is the result of quantitative change after some point. Such a qualitative change implies a fundamental change in social organisation, values and accompanying life styles. If this is indeed the case, future policies will have to be framed on a suitably specified alternative base in what turns out to be a historically unique setting. As the Spanish folk song puts it:

Caminante, no hay camino,
Se hace el camino el andar.
(Pedestrian, there is no footpath,
One makes a footpath by walking).

It would be well, at this point, to remind ourselves that the major topic of this paper is employment — hopefully, self employment. Employment — of any type — is after all an essential element in any type of life style. If the preceding discussion is to be *apropos,* it is necessary now to take the next step and ponder on an alternate policy that will provide for adequate and appropriate employment in rural areas.

FROM THEORY TOWARDS POLICY

In order to clearly expose the issues involved in formulating a policy of employment in rural areas, we will proceed with the help of a diagram that uses four quadrants formed by two axes (Fig. 1).

From north to south (N–S) we have an axis depicting the pattern of social organisation with S being a predominantly rural one and N a largely urban one. From west to east (W–E) we have an axis that depicts progressive improvements in the means of production — technology in the broadest sense of that much-used word. Thus it includes not only scientifically designed tools and increasingly sophisticated techniques, but also the structural and institutional means that must accompany them for their effective use. Thus industry requires a labour force free of ties to the land; the assembly line requires the discipline of the clock; and the modern super-market, itself a result of urbanization, requires a certain type of purchasing behaviour. It is the harmonious mix of these that we see along this axis. On the left (West) we

have a low (primitive) level of development of the means of production. The degree of their sophistication increases as we move east. This is a unidirectional path representing historical progress. (It does not seem possible, except in utopian dreams, to move west along it). For the moment we may assume a finite level of sophistication, as represented for example, by the contemporary level of the United States.

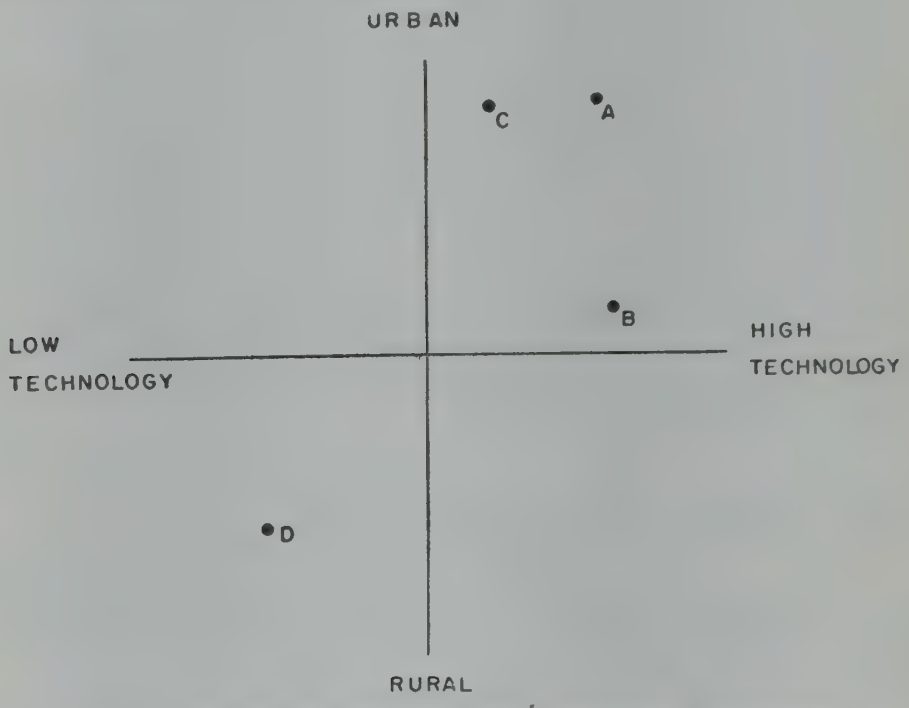

Fig. 1. The Technology-Social Organization mix. Examples:

A. High Technology — Urban
B. High Technology — Less Urban
C. Urban — Less Technology
D. Rural — Low Technology

A given social system — community, region, district, township — may be located at any point in this technology-social organization mix. That condition which is referred to as life style is influenced greatly by the position determined by the two axes; but life-style is understood more completely when the position on another, third, dimension is also known — the dimension representing the nature of the influence processes operating in that society, the politico-social force that represents, in turn, the value-ideology pattern the society has adopted. Thus, one may locate four

townships in four different societies, say the USA, Sweden, Japan and China, that may be located at more or less the same point in the north-east quadrant. The actual life styles of the peoples in these four social systems would now be similar in some respects as determined by the positions on the first two axes, but also different in some important respects because of the differences in positions on the third dimension.

We shall return to examine some aspects of "the invisible third dimension" later; for the present, let us continue with the first two. Modern economic growth may be considered as the path traced by a social system within the four quadrants in the course of its history. And if we consider modern economic growth as it has been considered by economists and historians of different countries, it should be possible to trace the path that these countries followed along these lines (Fig. 2).

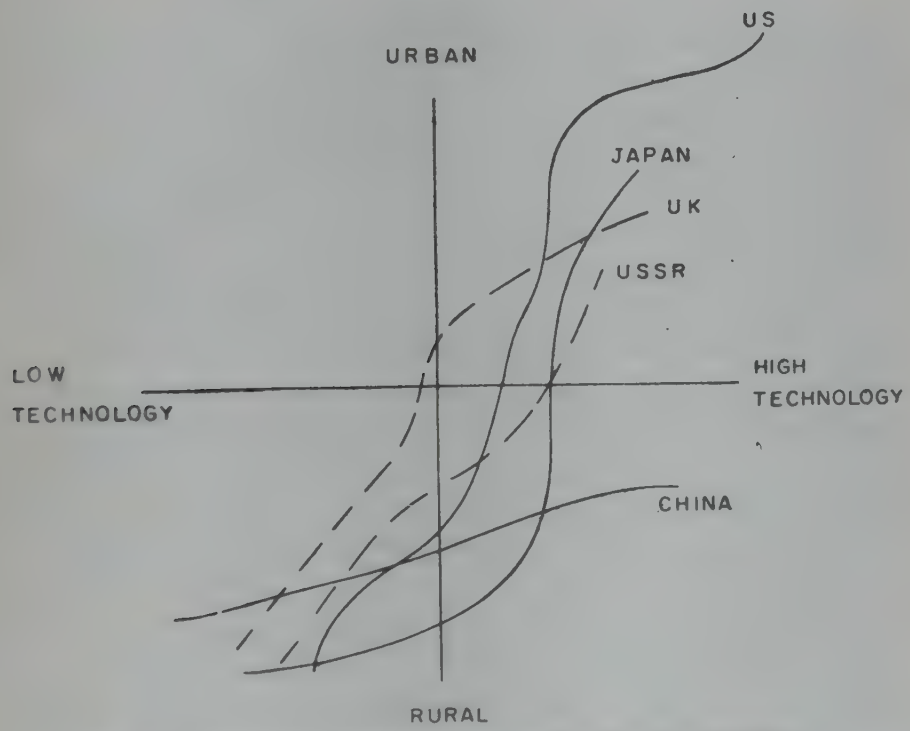

Fig. 2. Illustrative developmental paths of some Societies

The United States, for example, starting from a moderately high level of technology and a predominantly rural social set

up (and based upon its melting pot: European ancestry) has moved in some two hundred years to a very high level of technology and urbanization. The path is similar for the United Kingdom, for a more rural and lesser level of technology, but over a much longer period of time. A path can be traced out for other countries as well. Thus, Japan and the USSR, in spite of their very different histories and types of social organization, have followed paths that are broadly similar. It is no wonder that scholars (especially those from under-developed countries educated in the West) believed for a while that the path of modern economic growth is a universal one that all societies follow in the same way, but perhaps each at its own pace. That is to say, they must all climb a ladder along the diagonal, in our diagrammatic presentation.

For this presumption there is a good deal of underlying economic theory and policy in the field of economic development.

There is no reason, certainly no *a priori* one, to expect that the historical path of any society need be a straight line, that it must pass through the origin, that it must restrict itself to any particular quadrant, and so on. The axes do not represent measures of magnitudes of any usual kind. Societies start from different initial positions. Each one creates its own path, and moves along at its own pace. Some societies may stagnate in one level for a long period. In others, subtle changes may be taking place, as in Tokagawa Japan before 1968. It simply remains a fact of observation that most societies that have been studied in some detail have moved within a band along the diagonal, from South-west to North-east, *i.e.,* from a low technology-rural position to a high technology-urban one. There is no reason to believe that all societies will or should follow that path.

This point is borne out by the path traced by a country that is only recently being studied: China. The Chinese path, as the diagram shows, is quite different. We stress at this point that there is nothing "good" or "bad" or "right" or "wrong" about a path in itself. It is simply a description of a noticed historical tendency. The point is that now, by deliberate action, we can influence it in any given manner.

Let us now ask ourselves how India's path would look. There are several ways of tracing it because there are indeed several paths. It depends upon the precise question we ask. For there is no *a priori* reason to expect that a society must trace out only one path.

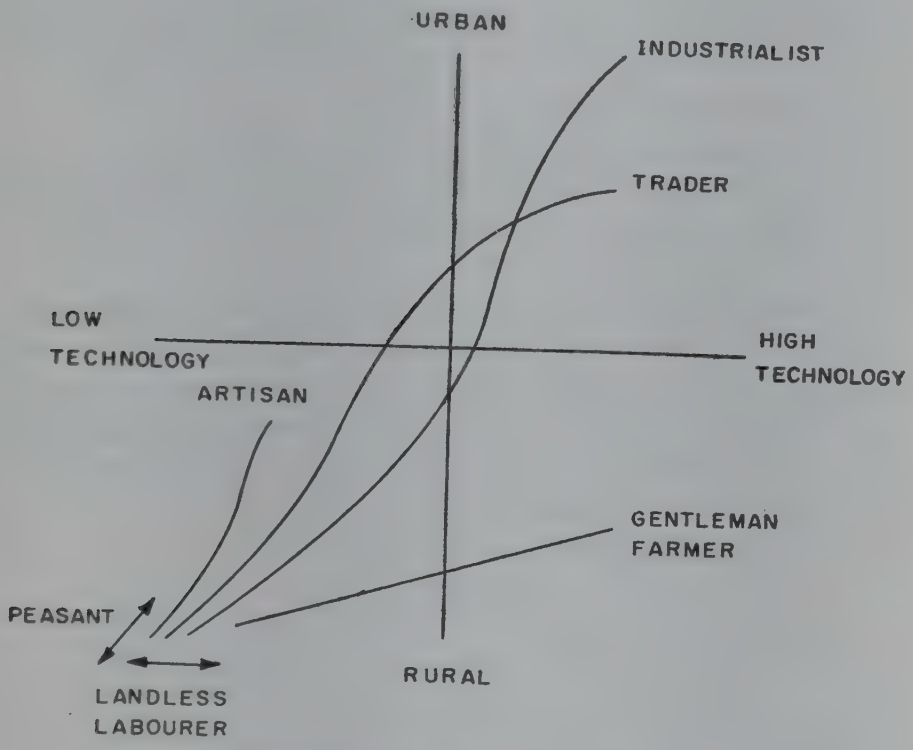

Fig. 3. Development in India: Which is the Indian path ?

The complexity of the Indian situation seems to start from the basic fact that there are many communities in India with distinct and strongly reinforced life styles (Fig. 3). "Development" is a kind of omnibus for which the general path would depend in fact upon the point of view of the observer. We have in Indian Society the landless labourer who is rural, and with little or no means of production. His is a path of relative, or near, absolute, stagnation. If we consider the peasant, he has experienced the gradually increasing sophistication of the means of production, but institutional conditions have not been such as to enable him to benefit from them. Such benefit has gone to the person whom today we call the "gentleman farmer". Typically, he is culturally a westernized person, often a retired service officer. He has

entered agriculture with a flourish, and in his hand the stagnant nature of Indian agriculture has been transformed. He has benefitted considerably, as the green revolution has shown.

The Indian artisan has also been touched by improved technology, and it has almost destroyed him. His environment has ceased to be rural; it has not become urban; he has lost his traditional craft; he has found no modern substitute. His miracle lies in his survival and for that he has to thank the positive elements in traditional Indian, rural society.

But the picture is not all bad. There are groups in Indian society that have traced out a path within "the diagonal band" for themselves. These fall into two categories: the "traders" and the industrialists.

There are, then, many ways of representing "the Indian path". Therefore, the question of employment has to be defined with respect to the path considered "relevant". The question is, simply, "employment for whom"? And it is this question that constitutes our point of departure so far as a discussion of a self-employment policy for rural areas is concerned.

To elaborate this point, let us return to Fig. 4.

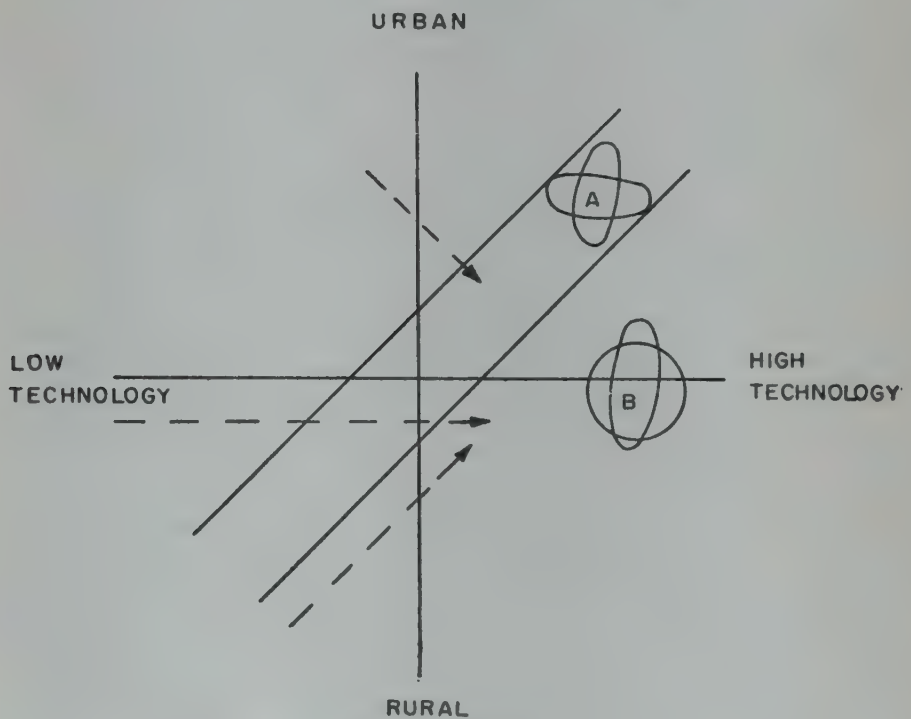

Fig. 4. Toward Alternate Objectives of Social Change

Till recently, development theory, and hence development policy, have (implicitly, perhaps) taken the region marked A as the objective to be achieved. Thus the "developed state of being" was visualized as one with a high technology which was highly industrialized and urbanized. The best example of such a state is the contemporary United States. Policies were designed to move the many underdeveloped societies in such a way as to make them resemble the United States.

Hence the great emphasis on industry. A casual reading of history may lead to the erroneous belief "that agriculture, after all, is a declining sector" and thus emphasis on industry has often (wrongly) been understood as being *versus* agriculture. Hence the faith on the transfer and transplanting of capital-intensive, labour-saving, "western" technology. Hence, also, the emphasis on the urban "growth centres" that would spur industrial growth. Hence, further, the emphasis on satisfying needs on an individual basis; for example, personal cars or scooters for transport rather than mass public transportation systems.

Such policies have met with fair success, we would argue, if the objective was to mould the traditional society in the image of the United States. It is admitted that there are problems in transplanting a foreign technology and culture, but this relates to the degree and speed of the change, not to the prospects of creating another US in the long run.

It is now abundantly clear that such policies do not lead to a solution of the major problems facing today's underdeveloped countries. The objective has to be respecified. It is not simply one of aiming at band A. We have to examine a given society, its resources, culture, etc., and then suitably specify its own, unique, set of objectives.

In the Indian context, productive work with mass employment is essential. We have found that we cannot get this by importing capital-intensive technologies. Economic theory tells us that a capital subsidy will lead to an efficient use of capital, perhaps, but not to increased employment. If we refer to the peasants

and landless labourers of rural India, we cannot think in terms of financing projects that will lead to substantial and significant increases in employment — our experience with agencies like SFDA and MFALDA and CSRE have shown us that they enjoy, at best, marginal and limited success.

How then can employment be created in our rural areas?

In a preliminary manner, we would argue that the objective must be specified, say, in band B. We must accept that the urbanization and industrialization that has already taken place in this country is irreversible. We must also acknowledge on the other hand that the poor and the rural folk have received little benefit from the large investments and plans so far undertaken. For them, employment has to be in the region (village) where they live. They need to transform local resources in the most efficient way into useful commodities. In this process:

* We cannot depend upon the market and the pricing system. The prices today reflect the viability of already developed technologies: the factor scarcity in them is that of the US or some other foreign country. This market system cannot now reflect the relative scarcities of factors in a village because the village is an 'insignificant atom' in the world market.

* We cannot depend upon the demand pattern generated by the market because, by definition, it reflects the desires of those who can afford to pay and not the needs of those who are poor.

* It follows that we must use an alternate economic calculus just as we need to use an alternate technology. Thus, we must not think in terms of financing projects for rural employment, but in terms of mobilizing local resources to meet local ends.

From the numerous cases of attempted rural development discussed in this very seminar it seems to be possible for us to cull out three main lessons as essential conditions for the success of such ventures:

(i) Intervention in a region to initiate a productive process must also ensure the marketing process so that goods and services produced are actually utilized.

(ii) The intervention process must ensure that the value added in the production process must accrue to the producers themselves, implying the elimination of middlemen in both inputs to and outputs of the production system.

(iii) The intervention/change agent or agency must be dispensable. The implication here is that his role is catalytic in the best sense of the term and, concomitantly, it results in the genuine development of the people concerned, as seen in their increased self-confidence, autonomy, participation, group cohesion and self-reliance.

If this is to be done, it is essential to specify our objectives at a local level in terms of local needs. Of course, national priorities and macro-level interlinks will have to be preserved. But we do not see any other method of proceeding with this task.

To organize and manage such a process of change it seems essential that it be done in a co-operative manner. Thus, we need here an alternate management style. To this question we shall now turn.

FROM POLICY TO MANAGEMENT

What we have before us is a task of the management of change. Any plan, any model, any programme of development, to be implemented and translated into accomplishments requires a management of change. The one feature that makes such a management quite different from the management of ongoing processes is that change — particularly, accelerated change — must stem from and also result in change in human behaviour (In every one of the twelve presentations before ours, we have seen that the success of the project/scheme/experiment/plan would depend "ultimately" upon changed behaviour of the people concerned. The words and phrases used, such as "awareness",

"motivation", "attitudinal reorientation", "group effectiveness", "self-confidence" and "value education", clearly indicate the recognition of the inevitability of behaviour change for development; the discussion also indicates, particularly by its short duration and even, sometimes, the avoidance of the topic after its mention, that this is an aspect of developmental planning that we are least comfortable with). What follows is an attempt — an exploratory and humble one — to at least understand the processes of behaviour change in the context of social change. We have attempted to bring within one conceptual framework the specific insights provided by several streams of behavioural science propositions, each with its own theoretical ancestry. To do this, we need to look at a wide variety of data, from laboratory experiments through case studies and survey research to project experiences; we need to look for both similarities and differences across several system levels of behaviour, from the individual through groups and organizations to whole communities; we need to be eclectic, drawing freely and yet selectively from a wide range of theoretical perspectives, from learning theories through group dynamics and field theory to General Systems Theory. What seems to emerge then is a set of about 10–12 observations at this stage, assumptions that might be pertinent for the discussion of development and change.

As Fig. 5 suggests, the more significant social changes involve:

(i) changes in (*a*) people, their cognitions, attitudes, values and motivations, and (*b*) the conditions in which the people operate — these two sub-sets of change tend to occur hand in hand, cyclically;

(ii) changes in the social institutions, the educational, legal, political and other institutions which form, together, the cultural and value context within which a society operates.

In a relatively stable social system, the main value dimensions underlying the social institutions exhibit considerable internal consistency; they represent the balance-restoring forces as naturally evolved by a historical process for that system; they are upheld by the dynamics of interaction between the two sub-sets (people and conditions); therefore, they tend to influence the

nature of changes in the two sub-sets, rather than to be changed by them. Changes that do take place in the institutions tend to be peripheral to the value dimensions, in the manner of expression given to the value complex, rather than at the core values themselves. Hence the weakness of isolated "radical" or "revolutionary" ideas to "change the system" in such a situation, a situation in which the social system as a whole, in consistency with all its constituent parts, has arrived at a purposeful dynamic balance with its own environment.

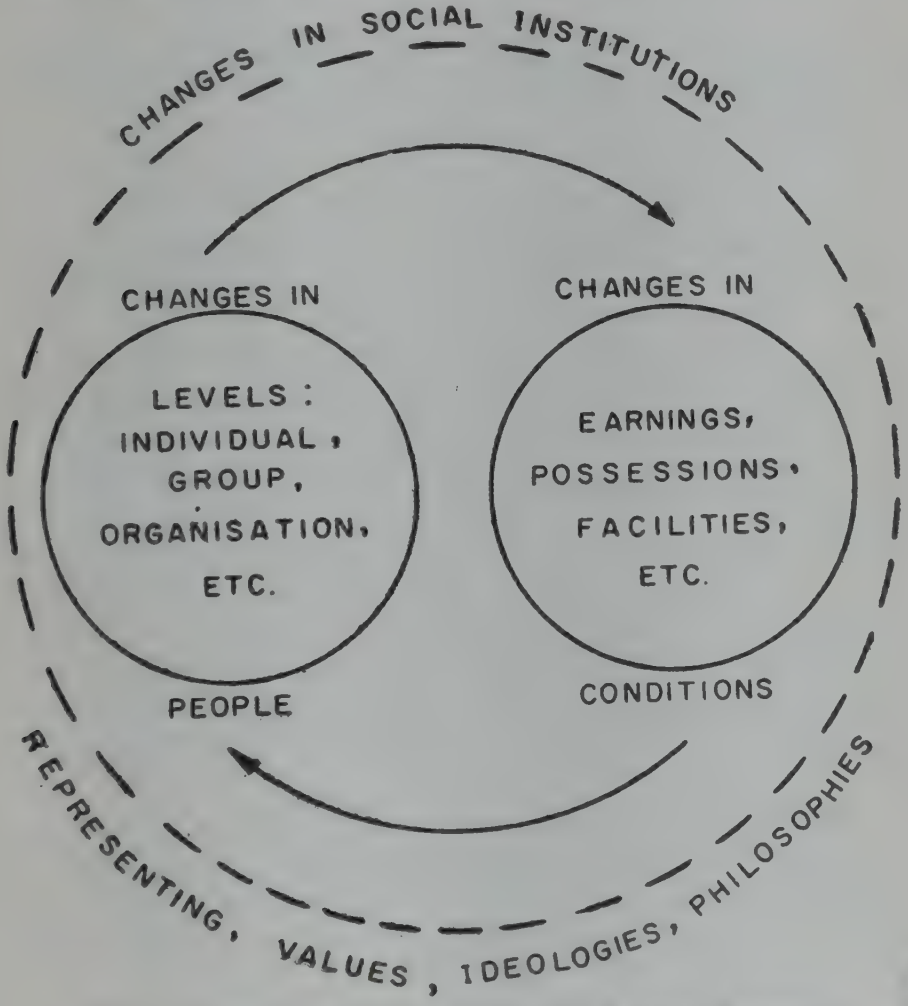

Fig. 5. Influence Processes and Change in Social Systems.

On the other hand, let us take the case of a social system that has not yet arrived at such a purposeful state of affairs or has, under some circumstance or the other, had its equilibrium dis-

turbed (*e.g.*, by a war or conquest, by natural calamities, by a change in its relations with other social systems, by its dependence for vital supplies, by a colonial past and so on). Here, it can be argued that the agitated states one observes in the dynamics of the sub-sets are, in fact, a reflection of the search for that set of societal values and those institutions that will be most purposive for that society. Hence the various attempts (and experiments) to "forge the national character", "discover our identity", "lay the institutional cornerstone", and so on.

In this search there have been, traditionally, two broad approaches to the planning, implementation and management of social change.

One approach tends to begin at the 'people' subset, on the assumption that if people's behaviour can be changed (*via* changes in beliefs and motivations?) the changes in conditions cannot but follow. This is in essence the 'higher productivity-greater benefits' logic in the pursuit of economic betterment. The other approach, somewhat deterministic in appearance, assumes that human behaviour itself (and therefore the constituent beliefs, motivations, etc.) is influenced by the conditions around men, and so one must do everything possible to improve those conditions first. This is the greater benefits-higher productivity logic. The first approach leads to hypotheses, principles and procedures in industrial engineering, incentive schemes, persuasion techniques and so on; the second to the social work and industrial relations principles right up to the concept of the welfare state. The current debate on population control contrasts these two approaches very well.

What is important for this discussion is not so much a preoccupation with the rightness or wrongness of either approach, but the sense that has to be made from a historical view of either approach through the experiences of many societies, including our own:

* An approach tends to be more successful if the underlying value is congruent with the prevailing value-complex. (e.g. value of independence *vs.* the value of fatalism). This might appear paradoxical, for any approach is employed

to change the value-institution bind, not reinforce it; but it is not necessarily so. A value-congruent approach can be used effectively to change the very value, as attitude-communication strategists can show.

* Following from the above, an approach tends to be more successful if the perceived outcomes of the approach fulfil prevailing needs (e.g. the need for emotional support, the need for security, etc.)

* Again, an approach itself induces processes of change in certain directions rather than in others; hence its relatively greater success if it is congruent with the end states most suitable for that social system. This stresses the importance of early identification of social institutions and values that would be appropriate for a set of physical-economic objectives.

* The two broad approaches seem to be extensions at the highest societal level of the two basic approaches to behaviour change even at the micro levels of the clinic and classroom — the attitude-behaviour sequence in the "insight" approaches and the behaviour-attitude sequence in the "behaviouristic" approaches.

* Following from the above, neither approach is likely to be effective by itself. The approaches are better understood as complementary inputs. Either input needs to be supported by the other afterwards, quickly, e.g., psychotherapy by carefully controlled behavioural opportunities (the essence of all rehabilitation) and structurally induced new behaviours (conditioned) by consistent cognitive and emotional support.

* Again, the two sets of inputs need to be planned to be mutually supportive rather than at cross purposes.

* Change strategies tend to be more successful when they recognise the qualitative differences in the inputs required

at the various system levels of change — the individaul, the group, the organisation, the community and so on.

* There exists today a fairly good understanding of the processes of behaviour change and a very impressive collection of methods and techniques to induce behaviour change — most powerful at the micro levels with diminishing (but still considerable) efficacy as one proceeds to higher system levels.

* Following from the above, change strategies tend to be more effective when there is internal consistency in the end behaviours and values sought among the various system levels.

* Since no two change programmes are identical, a change programme tends to be more effective when it has a research facet, constantly monitoring it — the basis of the concept of action research.

Relating the observations above to the point made earlier regarding the importance of examining a fresh and alternate life style for a society, a hypothetical programme of rural development would need for the "target village" the following types of inter-disciplinary, multi-tiered, programmatic, research inputs (What follows as a framework for action research was originally included in a manuscript for a forthcoming ICSSR publication by the same authors):

* an examination of alternatives possible, under the given conditions of resource endowments, employment patterns, judicial proesses, etc. — principal contributions, for example, from the discipline conventionally categorized as political economy.

* an examination of the appropriate institutional and organizational structures for the alternative(s) perceived — principal contributions from, for example anthropology and sociology.

* an examination of group processes, roles and interactions for the organizational structures conceived — principal contributions from, for example, social and organizational psychology.

* an examination of the anticipated problems of adjustment to induced change, training, assessment of human attributes, etc., — principal contributions from, for example, developmental, clinical and educational psychology.

The overlapping model of programming research suggested above is, of course, purely illustrative and therefore skeletal. In an actual programme its real interdisciplinary nature would be revealed in

(1) the tremendous interdependence of data among two or more specific investigations for analysis and inference;

(2) the conceptual unity in the total programme;

(3) the rigour in planning of both the individual investigations as well as the combined programme to maintain the conceptual unity;

(4) the phasing of the programme with a feedback information system to constantly monitor and reorient it;

(5) the pay-off in terms of the total insight gained from it, both for the endeavour on hand and for the contributing disciplines;

(6) the natural extension of the programme at suitable later stages to find interfaces with research studies from fields so far considered outside the programme, such as medicine and public health, architecture and civil engineering, education, technology assessment, etc.

This, after all, is integrated rural development. Our interpretations of the plea of the Honourable Minister for Finance of the Government of India reveals that integrated rural development must have as its backbone of support an integrated programme of action research on the lines suggested above.

Thus it would appear that future discussions on employment and development would be more fruitful if they turned away from certain traditional directions and were steered towards certain other directions:

* from the notion of the one best model, towards an acceptance of relevant patterns of employment — each pattern uniquely suited to the developmental needs of a particular region and yet maintaining, with the other patterns in the set, a cultural and value identity.

* from the means and methods orientation that comes out of the desperation of unemployment, to an orientation to the ends — of viewing employment patterns as part of a larger venture of arriving at an alternate life style — and therefore of the need to look for consistencies among the system levels.

* from the adoption of objectives on the basis of available methods and models, to working backwards from end objectives to appropriate and alternate methods and models.

* from an almost exclusive reliance on economic data and indices and yardsticks in planning, towards alternate, behavioural, measurements and indices. The end objectives are, after all, not points on economic dimensions for themselves, but certain (desirable) states of behaviour that we would like to associate with them.

We have come full circle to the prefacing remarks to this paper. We have attempted to forge certain links among social institutions, change policies, planning approaches and the ultimate objectives of social change. We have sought to reveal the intimate interconnections among the concepts employed in their analyses. Through this we see that, more often than not, perhaps inadvertently, we fail to distinguish ends from means. For instance, within one aspect of such social change, namely the employment pattern towards certain economic and social objectives, whether or not self employment leads to the larger objectives of social change within a clearly visualized set of institutional values is a function

not of the specific implementation is made and towards which the change is sought.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the comments and views, of other participants at the Seminar, which have been incorporated in the manuscript.

FOOD AND NUTRITIONAL ASPECTS OF RURAL DEVELOPMENT

Among the problems of rural areas the most severe ones are those associated with Food and Nutrition. This appears to be the most urgent problem which all developing countries must tackle on a war footing. When more than 30 *per cent of its population is steeped in acute problems of diseases which maim and kill, no nation will be in a position to concentrate on development in other spheres.*

Several scientists and scientific institutions in India are grappling with the problem of providing nutritious food to the millions of people in the rural areas. Coupled with poverty there are the problems of illiteracy and ignorance. Efforts to tackle these problems have met with reasonable success and the leaders of such programmes have presented their views in this seminar. However, there is an urgent necessity to tackle these problems in a concerted manner and this has been emphasised in the papers presented in this section.

NUTRITIONAL PROBLEMS IN RURAL AREAS

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Unfortunately, in our country, malnutrition continues to be one of the most important public health problems. Seventyfive to eighty per cent of our population, living as they do in rural areas and constituting as they do some of the poorest segments of our population, suffer the most in terms of nutrition. Much of the malnutrition in our rural communities is due to poverty and inability to buy the food they need. Some recent surveys conducted by the National Nutrition Monitoring Bureau have shown that almost 40 per cent of families with incomes around One Rupee per capita per day, subsist on diets which do not meet their calorie- and protein needs. But it needs to be emphasised that this alone does not explain all the malnutrition that we see. An important contributing factor is repeated infective episodes. The synergistic action between malnutrition and infection is well known. Poor nutritional status can not only pre-dispose to malnutrition but can also modify the course of many infectious diseases. Many deaths in children below the age of 5 years in rural areas in our country are recorded as being due to infectious diseases, but the real cause of death in many of these children is the underlying malnutrition. In addition, notwithstanding their poor nutritional status, the absence of adequate and quick medical care is an important determinant of the high mortality and morbidity seen in children of rural communities.

Children are the worst sufferers from nutritional deficiency diseases, and the three major disorders are protein calorie malnutrition, vitamin A deficiency and anaemia. Among adults, anaemia is a major public health problem, particularly in women of the child bearing age. Adult men do not appear to suffer too

much from obvious clinical manifestations of malnutrition, but the body weights of many such people are quite low.

Since a very high proportion of adult men in rural communities practice agriculture, the effect of this low body weight due to chronic inadequacy of food intake on work productivity must be considered as important. It is difficult to quantitate work output and even more difficult to determine whether low output is a result of nutritional factors, but some recent studies done at the National Institute of Nutrition, Hyderabad, do show that stature, particularly body weight, is related to certain types of work output.

Protein clalorie malnutrition in young children is one of the most widespread nutritional problems in our country. Anywhere between 4 and 5 per cent of all children below the age of 5 years living in rural areas suffer from kwashiorkor and marasmus — the severe forms of the disease. A great proportion of such children, who are not treated, die, and from this cause alone it has been computed that nearly half-a-million children die in our country every year. Our infant mortality is also one of the highest in the world, being about 1.5 times higher in rural India as compared to urban areas. Our toddler mortality rate is also one of the highest, 18 out of every 1,000 children fail to reach their fifth birthday. In well developed countries, this figure is less than one per 1000. Also, the proportionate mortality rate below the age of 4 years is as high as 40 per cent, which means that out of every 100 deaths in our country, 40 deaths are among children below the age of 5 years and there has been little change in this proportion over the last decade. This high rate of mortality means an unfavourable ratio of dependents to supporters. The death of any child before it comes of productive age is a total loss of all investment on that child. The economic loss as a result of this situation is thus obvious. The high infant and toddler mortality rates have other repercussions which are not inconsiderable. These deaths lead to an increased number and frequency of births, resulting in a high turnover of this unproductive segment of the population; also, this situation is a clear disincentive for rural families to limit their family size. The public health implications of both these are obvious. In addition, there is a growing body

of evidence to suggest that those who survive are not capable of attaining their full potential either with respect to physical stature or intellectual development though it is now becoming clear that in the past, we have tended to overstate the importance of malnutrition *per se* in mental development. While the incidence of severe forms of malnutrition, in itself, is high, it does not indicate the real extent of the problem, since a much larger proportion of children suffer from mild and moderate degrees of malnutrition. It is these forms that, from the point of view of physical size in adult life, become relevant and as mentioned earlier, if size and productivity — at least of some types, are related, the smaller size would mean some form of functional handicap.

It had been believed so far that the diets of pre-school children belonging to the poorest segments of the population were deficient in protein — both in quantity and quality, and that this was the main reason for the widespread prevalence of protein calorie malnutrition. Earlier efforts, therefore, to control and prevent this condition were directed at formulating protein — rich foods and developing protein concentrates. During the last few years, however, this concept has undergone considerable change and it is now almost universally recognised that at least in the Asian countries, where the diet is cereal and legume-based, the dietary inadequacy is one of calories and not of protein. There is sufficient evidence to show that if these children were to consume the existing diets in amounts to meet their calorie needs, their protein requirement would be more than met. The realisation of this very important factor, that what we are dealing with is a 'food gap' and not a 'protein gap' has obvious implications for the control and prevention of protein calorie malnutrition among children. In fact, operational research studies have shown that by simply bridging the calorie gap, the growth of such children can be considerably stimulated.

The second major nutritional problem in our country is blindness arising out of vitamin A deficiency. The real incidence of this condition is not known, but based on hospital statistics, it is clear that several thousands of children become blind every

year as a result of vitamin A deficiency. The single most important cause for the widespread prevalence of vitamin A deficiency is inadequate intakes of the vitamin through the diet. Preformed vitamin A is present only in foods of animal origin, which are expensive and, therefore, beyond the reach of the poor. However, B-carotene — the precursor of vitamin A, is present in fruits and vegetables, which are relatively cheap. Inclusion of green leafy vegetables in the habitual diets of children will go a long way in reducing the extent of the problem. This calls for intense nutrition education and in spite of such efforts, no real impact seems to have been made.

In an effort to minimise blindness due to vitamin A deficiency, short-term programmes have, in fact, been suggested and implemented in several parts of the country. This has consisted in administering 200,000 international units of vitamin A once every six months to children between the ages of 1 and 5 years who are at greatest risk of developing deficiency. At least in some States, this national programme has been run effectively, and the incidence of eye signs ascribable to vitamin A deficiency has been brought down by almost 75 per cent.

Anaemia, both in children and in women of child bearing age, is one of the most widespread diseases in our country. Every third child living in rural India is anaemic and every alternate pregnant woman during the last 3 months of pregnancy suffers from anaemia. The meaning of this anaemia will become clear when it is realised that 20 per cent of all maternal deaths in our country are believed to be due to anaemia, and severe anaemia is one of the important reasons for abortions, premature deliveries and low birth weight of infants. The birth weight of an infant is closely related to its chances of survival and the importance of anemia as a public health disease thus becomes evident. Also, subjects suffering from anaemia are more prone to develop infectious diseases as compared to those that are not anaemic and for this higher susceptibility, anaemia need not be very severe.

Much of the anaemia seen in our country is of the iron deficiency type. This is so in spite of the habitual diets containing seemingly adequate amounts of iron. Since the cereal-based

diets contain relatively large amounts of phytate, the iron present in the diet is not available for absorption, thus leading to an iron deficient state.

Among measures that can be taken to control and prevent iron deficiency on a public health scale is the fortification of a suitable item of food with appropriate amounts of iron. Attempts are being now made in our country to fortify common salt with a suitable iron preparation as a public health measure to control this important disease.

The extent and importance of these three nutritional deficiency diseases are, therefore quite clear.

There are several diseases, which are not strictly nutritional, but are associated with the consumption of foods. Foodgrains, when stored under unsatisfactory conditions, are frequently attacked by fungi and some of these fungi produce toxic substances. We now have evidence to show that the consumption of such badly stored, mould infested foodgrains has relevance to human health. Aflatoxins — a group of toxins produced by a fungus — *Aspergillus flavus,* are powerful hepato-toxins, and in experimental animals, including the monkey, can produce not only cirrhosis but also cancer of the liver. Many foodgrains are known to become infected with this fungus and a recent outbreak of hepatitis in parts of rural Gujarat and Rajasthan, just over a year ago, was ultimately traced to the consumption of maize heavily infested with this toxin. Groundnut is another crop that is highly susceptible to aflatoxin contamination. The reason for the development of cirrhosis in our country is often not known, and the possible role of aflatoxin, therefore, needs proper evaluation.

Since poor storage condition under high humidity is an important factor in the growth of this fungus, the most rational method of minimising the risk would be to improve storage conditions. However, this must be considered to be a long term solution, which involves considerable amount of education. In the meanwhile, another approach that has been considered is the identification of varieties of maize and groundnuts which would resist fungal contamination and elaboration of the toxin

even under adverse conditions. In fact, a few such varieties have been identified and it is possible that selective propagation of these varieties will help in at least partial control of aflatoxin contamination of foods.

Another foodgrain — *bajra,* is known to be attacked by ergot and the consumption of ergoty bajra has been known to lead to ill-health. An outbreak of bajra ergotism was recently reported from several villages in Udaipur. The possible role of such fungal toxins in human ill-health should not, therefore, be under-estimated. This problem is present all over the country, but its impact is perhaps felt to a great extent in rural areas, for several reasons. It is well-known that nutritional status modifies the adverse effects of practically all toxins and the nutritional status of poor rural communities is particularly poor. Also, social and cultural practices in rural areas pre-dispose certain segments of the population to greater risk. The practice of paying the wages of agricultural labourers by landlords in terms of foodgrains is one that is relevant. Generally it is the cheapest and the most damaged grains that are used for this purpose. Because of extreme degrees of poverty, such labourers have no choice but to consume these grains. Most such groups, in addition, are not aware of the health hazards of consuming infested grains. The morbidity in this segment of the population may, therefore, be expected to be of a high order.

More recently, an outbreak of another disease characterised by liver damage and ascites reported from parts of Madhya Pradesh was traced to the consumption of the staple contaminated with a weed seed. This weed seed, on an analysis, was found to contain pyrrolizidine alkaloids, which are known to be toxic to the liver.

Among measures that have been recommended to overcome this problem are the de-weeding of the *jhunjunia* plant before it flowers and the seeds are set and if this staple has already become contaminated, to use a proper sieve at the household level to quantitatively separate the staple from the weed seed. This is

practicable since the size of *jhunjunia* seed is quite different from that of the staple.

Though the single most important factor for this widespread malnutrition is economic status, it is obvious that inadequate availability of medical care, the unsatisfactory physical environment and other social and cultural factors operate in determining the severity of malnutrition. It is, therefore, clear that problems of nutrition cannot be solved in isolation, but must be tackled through a carefully planned, comprehensive integrated rural development programme.

RURAL NUTRITION PROBLEMS: CAUSES AND CURE

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INTRODUCTION

So many of our people live in rural areas, in settlements with a population of 10,000 and below, that nutritional considerations for all of India, may seem to be applicable to rural nutrition. While this is true, there are some differences between urban (particularly big city) nutritional problems taken as a whole, and rural problems. Within the rural macrocosm are special groups with distinctive needs. An attempt will first be made to outline various parameters which influence nutrition. Thereafter remedial measures can be considered.

NUTRITIONAL PARAMETERS—URBAN/RURAL DIFFERENCES

Urban incomes and expenditure are on the average higher than rural. Dandekar and Rath's study of poverty in India gave average annual expenditure figures in 1961 of Rs. 356 and Rs. 259 per head for these groups, which in 1968 had risen to Rs. 365 and Rs. 269 respectively. Large metro cities in India have higher per capita expenditures than the country as a whole: for Bombay, Calcutta and Madras these were between Rs. 850 and Rs. 950 annually in 1972 against Rs. 660 for the country as a whole.

Yet this does not mean that urban dwellers are always nutritionally better off than rural. Detailed studies of dietary intakes have been made in several states in the country by the Protein Foods and Nutrition Development Association of India. In

three of these states, Tamilnadu, Gujarat and Maharashtra, for example, calorie and protein consumption were both higher in rural than in urban areas, while in Kerala the reverse was true, the differences even here being marginal. The metro city of Madras has a distinctly lower average intake of both calories and proteins than does the state as a whole. In particular, the poorest of urban people, the slum dwellers, are distinctly worse off than even the lowest segments of rural people.

Food intake is the resultant of many individual component forces. Even casual reflection suggests such factors as income, cultural beliefs, family size, the owning of land or otherwise, the nature of occupation, and so on. If action has to be taken to improve nutrition, some quantitation of these factors is necessary.

INCOME AND FOOD

It takes money to buy food, and it will be obvious that income will play a large part in the nature and quality of the diet that is consumed. Dandekar and Rath in their classical study worked out the expenditure necessary to be able to buy 2,250 calories per head daily. Defining the poverty line on this basis, they estimated that in 1961 an expenditure per head per month of Rs. 27.50 in the rural areas and of Rs. 40 in the urban areas (because of higher prices) would be necessary to rise above the poverty line. In 1971 it was estimated, following a rise in prices, that even in rural areas an expenditure of Rs. 40 per month would be necessary, and that on this reckoning 68.5 per cent of the rural population, or about 300 million people, were below the poverty line. And to take a fleeting look at the other end of the scale, less than 2 per cent of rural families could claim an annual income of Rs. 10,000 or more.

Surveys which relate diet with income show how strong is the correlation. Take adults first, and consider those from families with low (below Rs. 100 p.m.) and high (above Rs. 500 p.m.) incomes. In Tamilnadu, calorie consumptions of these adults were 2,019 and 2,331 respectively, and protein intakes 60 and 69 gm. For Kerala the calorie figures were 1,751 and 2,183, and

the protein figures 44 and 62 gm. These differences were even larger when other members of the family, like preschool children and school children, were compared between different income groups. To illustrate with figures from Tamilnadu only, the preschool child of the low-income group averaged 859 calories and 26 grams of protein, and the same child from the high-income group received 1,206 calories and 42 grams of protein. This very large divergence was seen also in school children ranging in age from 6 to 15 years: against 1,504 calories and 43 grams protein for school children of the poor group, the wealthier group of school children consumed 1,945 calories and 57 grams of protein. States like Gujarat and Maharashtra showed the same pattern.

A study made by the National Institute of Nutrition, of families round Hyderabad, brought out a similar picture. These were classed into three groups with monthly family incomes averaging Rs. 800, Rs. 500 and Rs. 250 and a detailed study of food patterns was made. With decrease in income, *more* cereals were eaten, but pulses were about the same; however such items of food as roots and tubers (meaning potatoes, sweet potatoes and yams), fruits, milk, and fats and oils were strongly correlated with income level. As a result, in nutritional terms, while calorie and protein intakes did not differ greatly with income, the intakes of such nutrients as calcium, vitamin A and riboflavin were distinctly lower at the lowest income level because the protective foods which carry these had been dispensed with. One can expect such differences to be magnified among the very poor living in rural areas where the best value for money in terms of a full stomach would lie in very large consumption of cereals.

An examination of the expenditure break-down on an all-India basis brings this out clearly. In cities taken as a whole the percentages of expenditure on various classes of foodstuffs like cereals and pulses, vegetables and fruit, milk and milk products, animal foods, fats and oils, and sugar or jaggery are close to those calculated from the quantities recommended by the Indian Council of Medical Research (ICMR) at current prices; this gives a ratio for cereals plus pulses, compared to other foods, of 30 : 70. Rural expenditures were heavily weighted in favour of cereals and pulses,

to the detriment of protective foods (ratio 66 : 34), while urban areas taken as a whole, lay in-between (ratio 48 : 52).

Thus income or buying power plays an extremely important role in nutrition, both in overall terms of calorie and protein intake, and even more so in terms of intake of micro-nutrients like vitamins and minerals.

COMPONENTS OF INCOME/EXPENDITURE

As is to be expected when incomes are low, a high proportion has to be spent on food. In 1961 this was estimated to lie between 83 and 74 per cent for rural consumers, the proportion falling with increasing income. Very poor peoples, tribals for example, spend as much as 90 per cent of their miserable incomes on food.

One reason for the poor nutritional status of city slum dwellers is that a much greater proportion of their income has necessarily to go towards such needs as shelter and fuel, which in rural areas often entail little or no actual expenditure. In 1961, against figures for "other expenditure" of 7.3–11.9 per cent in rural areas, the corresponding figure for the poorest urban dwellers (with a monthly expenditure of upto Rs. 28 per head) lay between 8.8 and 20.5 per cent.

Inflation has played its part in keeping nutritional levels low by reducing buying power even when incomes have risen. The average annual income of an Indian was Rs. 305 in 1961 and rose in 1973 to Rs. 688, but the price index of foodstuffs, taken at 100 for the year 1961, had risen to 250 in 1973, 356 in 1975 and to an average of 305 during the 12 months of 1975–76. In 1973 it was calculated that the buying power of the income of Rs. 688 was only Rs. 337 at 1961 real prices. Thus in the 12 years that had elapsed, only a moderate real increase of 10 per cent in average income had occurred. Actual surveys in a village near Hyderabad in 1964 and again in 1974 showed that while mean family income had gone up 2.7 times, this was almost exactly offset by a corresponding rise in the cost of food, so that nutritionally the status quo was unchanged.

Shortages of foodstuffs are the major reason for inflation. Export of food also has a distinct inflationary effect. Not only does this derive from resultant shortages following exports, but also from prices rising internally to international levels which are usually higher. The high prices of spices in India are a case in point.

Debt and the interest on it is a facet of income, dragging down further its tiny value. The total rural debt has been variously estimated to lie between Rs. 2,000 and Rs. 4,000 crores. An average small farmer or agricultural labourer is indebted by amounts of Rs. 250–350 each, and half of this has in the past been at interest rates of over 12½ per cent.

FAMILY SIZE AND NUTRITION

Next in importance to income as a determinant of nutritional level is family size. Studies have shown that, other factors being the same, families with 2 children are able to meet 90 per cent of calorie needs, against 78 per cent where there are 3–4 children, and 66 per cent where the children comprise 5 or more in number. Protein needs were fulfilled in parallel fashion. In another study, calorie intake was below 2,000 calories per head where the family size averaged 5–6 or more (both rural and urban), but was above this figure in families of similar background but in which the family size was below 5.

Cases of protein-calorie malnutrition occur much more frequently in children born later in the family; in one study, 61 per cent of malnutrition in a community of children was made up of birth-orders 4 and more. In the pediatric ward of a hospital in Hyderabad, a disproportionate percentage of the beds was occupied by children of birthorder 4 or above. An eminent Indian nutritionist has stated that reduction to a family size of three children would cut down serious protein-calorie malnutrition by a figure of 60 per cent.

Family size is itself conditioned inversely by income. In families with an income of over Rs. 400 per month, only 11 per cent

had more than 4 children; but when the income was below Rs.200 per month, the figure was 22 per cent. This in turn has an effect on the health of the newborn infant. At the high income level, infant birthweight fell below 2.5 kg only in 23 per cent of the cases, but at the lower income level, there was twice this percentage of such low-weight babies. And the toll taken on mothers is enormous: considering all the adverse factors, it has been calculated that to achieve the present family size of 5, women in India have to go through 8 pregnancies on an average. When one remembers the higher nutritional needs both in pregnancy and lactation, the toll taken of these women, constantly in a state either of pregnancy or lactation, can well be imagined.

Even belief plays its part. It has been computer-calculated that if a man, when he dies at the age of 65, is to have one surviving male child, the number of births required in India would be 6.5, not far from the actual.

It is often felt that poverty has the effect of increasing fertility. This is not true, and Gopalan has shown how poor nutrition actually depresses the high rate of population increase in India. Such factors as higher age of first menstruation, high foetal death rate, and high maternal mortality are all severe depressants of overall population. The potential fertility of well-nourished people is always much higher but is controlled by birth limitation practices.

Reduction of family size is thus an important facet of improved nutrition; ultimately this will be reflected in a smaller total population.

KNOWLEDGE AND EDUCATION

It is often stated that we need to educate our people into changing their diets for the better, and the implication is that it is lack of knowledge that comes in the way. The strong corrrelation between income and nutrition would itself tend to suggest that this is not so, and that education or knowledge can at best make a marginal impact on nutrition when the economic means to use this knowledge is lacking.

There is little correlation between literacy and nutritional level. Madhya Pradesh has a low literacy rate (22 per cent) but high levels of calorie-protein intake (2,779, 98 g), and Kerala, with a high literacy rate (60 per cent), has low levels (1842 cals., 47 g protein). Punjab/Haryana and Gujarat, with medium literacy levels of 34 and 36 per cent, have high (2832, 84 g) and low (1612. 54 g) nutrient intakes. Bihar has both a low literacy level of 20 per cent, and low nutrient intakes (1865 cals., 56 g of protein). Literacy rates are always higher in urban than in rural areas, but as we have seen this is by no means always reflected in nutritional levels. Even within Kerala State some interesting correlations have been documented by our studies: rural dwellers and urbanites share a similar literacy profile, and in turn a similar awareness judged by such indices of nutritional knowledge as awareness of vitamins, or of the need for special food during pregnancey or during lactation. Further, high income groups, with a high educational profile, likewise show a much greater degree of nutritional awareness than low income groups. Yet in Kerala the general nutrient awareness even among the lowest income groups is far higher than in a state like say Maharashtra, but this has little effect on nutrient intakes, which are not dissimilar. It is lack of buying power that is operative.

Education can clearly raise nutritional knowledge, and by suitably fashioning the educational content, the many parameters that influence nutrition can no doubt be influenced. Thus rural mothers have been found, in studies at the National Institute of Nutrition, to retain a high proportion of nutritional knowledge when this is properly imparted to them; even radio talks were well assimilated, especially in groups with some education. Studies in Coimbatore by the Sri Avinashilingam College of Home Science have shown that nutrition education imparted to school children by such methods as songs and flash cards is transmitted quite effectively to their mothers at home.

CUSTOMS AND TABOOS

All of us tend to eat what our forefathers ate; there is no harm in this since there are many ways of achieving balanced diets

within the Indian context, but some customs and taboos do not stand the test of nutritional scrutiny. The concept of hot and cold foods is widespread, and leads to such practices as the avoidance of curds, buttermilk and fruit in winter, or of flesh foods in summer. The almost universal taboo against papayas being eaten by pregnant women for fear of abortion is unfortunate, since papayas are a cheap and common source of vitamin A. In South India pumpkins and jackfruit are similarly avoided, as is fish in states other than Kerala. Foods considered useful in the south during the nursing period, like rice, curd, green leafy vegetables and betel leaves smeared with calcium, are avoided for instance in Gujarat. Children are not given bananas for fear of convulsions, and to their misfortune are dosed with castor oil during bouts of diarrhoea.

A distaste for wheat even when available freely is all too frequent in the south, as is the common practice of cooking rice in an excess of water which is then poured away with all the vitamins and minerals it has leached out. So strong is the preference for river fish in Calcutta that sea fish is hard to sell at even half the price. Highly nutritious common foods, like green leafy vegetables, our familiar *sags* and *keerais*, rich in a host of vitamins and minerals, or the *amla* or *nellikai,* a storehouse of vitamin C, are given little importance.

Low income affects least the intake of cereals and pulses, and thus of calories or proteins; a marked lowering of protective food intake, carrying vitamins and minerals, is almost always apparent. Education towards increased consumption of inexpensive green leafy vegetables could remedy this to a considerable extent.

RURAL SEGMENT OR OCCUPATION

Rural dwellers fall into several categories. There are landowning farmers, marginal farmers, agricultural landless labour and tribal groups. Most are poor, and about half do not have the spare income for any more food.

Let us proceed from the bottom upwards. Tribal people are almost all very poor, some more so than others, and their nutritional levels are sometimes pitifully low. A tribal group of the Dharampur district in Gujarat consumed 361 g of cereals daily against the ICMR recommendation of 342 g, but pulse consumption was 20 g (ICMR:58 g) and all other foods totalled just 29 g (ICMR:541 g). Calculated in nutritional terms this came to 1,436 calories daily (ICMR:2124) and 34 g of protein (ICMR:46), while the levels of vitamins and minerals must have been far below any nutritional norms. Many other tribals are even worse-off than this, though some, like the Onges of the Andamans and the Abors of Assam, have exceptionally high levels of nutrition, far above the average for the country. Children of Kerala fishermen showed a high proportion of anaemia; one-third showed advanced malnutrition and only 2 per cent were normal. Such badly-deprived groups require special attention.

There is another large segment of some 45 million unemployed rural dwellers, whose average income is only about Rs. 150 annually. This group includes 17 million children and 1.5 million nursing mothers. These constitute the lowest 10 per cent of the population, with almost minimal intakes of nutrients, barely enough to live.

A cut above this are marginal farmers, those owning somewhere around 5 acres (2 hectares) of land. Obviously, depending on the nature of this land, whether irrigated or rainfed for example, incomes and hence nutritional levels vary enormously. The new technologies engendered by the green revolution have helped in a big way. Where irrigation is available it has been shown that even a $1\frac{1}{2}$-acre holding, if sown to 2 crops of rice and wheat, yields Rs. 1,600 annually. In areas with assured rainfall, 4 acres under paddy and then 2 acres under pulses (on residual soil moisture) will give the same order of return. Prior to the green revolution, even 5 acres would have yielded barely half this income.

Farmers with larger holdings would obviously count as the rural rich, and require no special priorities.

NON-NUTRITIONAL INTERVENTIONS

It has been said that the eradication of malaria following the second world war did more to conserve and promote nutrition than any nutritional step could possibly have done. Diseases like typhoid, cholera, plague and smallpox are far less significant now, and have reduced the incidence of both mortality and morbidity, and improved general nutrition. But the effect of such conditions as gastroenteritis, colitis and dysentery has thereby become more pronounced; provision of a protected water supply could do a great deal. Of the many possibilities of intervention, it has been argued that certain steps would benefit mainly the higher-income rural groups, like compulsory schooling, curative treatment at hospitals, and reduction of family size by contraception. Other programmes could help a wider spectrum including rural dwellers, such as a protected water supply, eradication of communicable diseases and epidemics, triple immunisation at birth, and the elimination of worms and intestinal parasites. In the context of poverty, even such steps as a calibrated pricing and distribution policy for essential needs may do more than many direct nutrition intervention programmes. Asok Mitra has said: "It is important to investigate the relative importance and dimensions of the holes in the leaking human bucket to arrive at notions of what programmes, at least cost, will confer the greatest benefits".

IMPROVING RURAL NUTRITION

Let us recapitulate the points which emerge from the review made so far. Essential to any improvement in nutritional status of rural dwellers is to increase their income and for this specific steps for specific groups like tribals, landless labourers and marginal farmers will be particularly necessary. The impact of such an increase could be greatly enhanced if food prices could be reduced or held level, and this comprises more food production, greater procurement, larger storage and equitable distribution. Large family size affects nutrition adversely, and is related in turn to social mores, life expectancy at birth, and living conditions in general, while spread of family planning practices can directly hasten the limitation process. Health services, such as provision of triple antigen or deworming, could serve as important plugs

for the leaky nutritional pot. Education in general, and education for village life styles in particular, properly designed, could upgrade nutritional status. How could one set about achieving these?

INCREASING INCOME

For the landless poor and tribal peoples, remunerative occupation is clearly necessary. Not only must a fair wage be set, but some legal machinery to ensure that the wage is paid is also important. Self-regulating wage levels obtain when there is a multiple demand for labour services, and this will mean the development of a rural works programme of road building, tank development, farm bunding works and the like. Keeping of poultry or milch cattle adds to income. One milch cow can realise Rs. 400 annually for its owner, and 20 hens about Rs. 250; at the same time some surplus milk and eggs are available for domestic consumption with great nutritional benefit. This has been found to happen in practice: in Gujarat, one-third of the milk produced, even when the quantity rises, is used by the owner. A good marketing system for collection at fair prices and effective distribution to users is essential. Experience shows that the system is best organised as village cooperatives. The many cooperatives in Gujarat for milk, and the cooperative society in Surat for eggs, are examples of how this can be organised to include even such components as moderately-priced feed, veterinary services and even general village improvement. Rural industries of the household type are additional sources of income. These include weaving, spinning, basket and mat making, and fashioning of combs, buttons and chappals. At a slightly higher level of sophistication are the producing of tooth powder, hair oil, soap, matches and the like.

Capital is required even for the most modest venture. There has been a welcome reduction over the last decade in borrowings from money lenders at high rates of interest, from 61 per cent of all rural borrowing in 1961 to 37 per cent a decade later, with a corresponding rise in borrowing from institutional agencies and cooperatives. Alongside, total borrowings have doubled. The marked increase in rural bank activity that has occurred since 1975, which is to be further extended, is a welcome development.

This is only just: rural credit needs have been estimated at Rs. 350 crores annually, whereas even in 1974 as much as Rs. 850 crores had been mobilised from these very rural areas (though later largely invested in remunerative urban enterprises).

Marginal farmers must have their land base strengthened, and the green revolution has shown the way. It has been repeatedly proved that size of the holding is irrelevant to productivity provided inputs are sufficient. Suitable crop rotations depending on water availability and land type, use of high-yielding seeds for sowing, and employment of dryland technologies of mulching, sprinkler irrigation and bunding all ensure a better return from land. It has been pointed out that, potentially, a farmer can get much more by proper cultivation of his own land than by taking employment elsewhere; what they need is cash for inputs.

Another facet is the distribution of land to the landless. While some 10 million hectares of land have been acquired under the new ceiling laws, very little has been distributed so far. Land ownership is the first step towards bettering the condition of the very poor.

EQUITABLE FOOD DISTRIBUTION

Food production, at least of cereals, is now firmly set on an upward path and more of it must be made to reach the poor. Procurement of essential foodstuffs, its storage in good condition, and its distribution at fair and even subsidised prices are ways of doing so, and much has been done. Procurement of cereals, which for many years stood at around 10 million tonnes annually, was twice this figure in 1976, while storage of foodgrains has reached the astonishing figure of nearly 20 million tonnes. Extension of these activities to cheaper cereals like *bajra* and *jowar,* and to pulses and oilseeds, seems desirable to ensure a better quality of food to the poor at controlled rates. Differential pricing is not easy to implement. except where the qualities of the commodity are obvious even by inspection, e.g., coarse and fine rice varieties.

Distribution of foodgrains throughout the country through the ration system in the big cities, and through the fair price shops

now numbering about 200,000, needs to be strengthened. The use of the system for disposal of other commodities deserves consideration. Thus a balanced food blend of the *Balahar* type, consisting of roasted cereals, pulses and oilseeds, with added vitamins and minerals, if made available through the public distribution system for children in lieu of their cereal quantum, could go far in improving their nutrition at a critical period. Subsidised sale of this food to children between 1 and 6 is certain to show a favourable cost-benefit ratio.

Payment for work in food rather than money is a concept that has been effective in improving family nutrition. An extension of the concept could be that this food takes the form not just of raw cereals as at present but of protective foods like milk, or vitaminised food mixes like *Balahar,* since lack of micro-nutrients is an important characteristic of the diets of low-income groups. In the long run, the best answer to vitamin and mineral deficiencies would be the growing of green leafy vegetables by individual families for their own use.

LIMITING FAMILY SIZE AND POPULATION

Better living conditions, by a feedback mechanism, lead to a reduction in the number of births. When this betterment is slow, and when death rates drop sharply by better health care, actual populations rise extremely fast, and more positive steps to control them are called for. The legislation now in motion to raise the age of marriage to 18 years for girls and 21 for men will undoubtedly do a great deal by cutting out a few highly-productive years. Disincentives to large families in employment and service conditions may have only small direct effects on population, but the deterrent and propaganda value for others not in service, by a ripple effect, could be considerable. Spread of facilities for all types of contraception — rubber condoms, IUDs, sterilisation and termination of pregnancy — could have a useful cumulative effect.

It has been said that perhaps the most effective contraceptive device is prolonged feeding of the baby at the breast. Prevalence

of the practice in India has in practice led to an average interval of 32 months between births. Especially in urban areas the practice is rapidly being replaced by bottle feeding using commercial foods., often for psychological reasons of inability to breast-feed. Medical personnel should use every means of persuasion to counteract the trend.

HEALTH SERVICES

Nutrition in the last analysis is good health, and the availability of such health services as triple immunisation after birth, and occasional deworming, would perhaps do more than any direct nutrition intervention. The country today has a network of primary health centres (PHCs) and the aim should be to provide one within walking distance of every village, say 5 km. The services of local *dhais* (midwives), *vaids, bhagats* and *unani* practitioners, who have a smattering of health knowledge and are accessible to and have the ear of the villagers, should be put to positive use by modernising their knowledge through exposure to the work of the PHC and even, participation in it. After all these are the 'barefoot doctors' of our country.

EDUCATION

Education in general, education for rural life styles, and health and nutrition education are long-term interventions which must start now. Gandhiji advocated the basic concept of rural education as learning through doing, the training in his own words to be "natural, responsive and therefore the quickest and cheapest in the land". He even visualised that such craft-based learning would pay for itself! It is realised strongly today that education as now practised is divorcing people from their own environment, and that some correction particularly for rural dwellers is necessary. The concept of rural *ashramshalas* has been advocated, which will offer free board and lodging to very poor children; this will provide better nutrition while learning, and leave more food for the rest of the family at home. The content of education at these institutions should draw on the environment and be stimulated by its needs. The possibility of education through even such

an advanced technology as television, following the SITE (Satellite Instructional Television Experiment) exercise. is an exciting new dimension of what might be possible to supplement daily schooling even in remote areas.

FOOD TECHNOLOGY FOR RURAL DEVELOPMENT

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In India eighty two per cent of the total population are rural based. According to the 1971 census, in the four Southern States the rural population was as follows: Andhra Pradesh 77 per cent, Karnataka 76 per cent, Kerala 84 per cent and Maharashtra 69 per-cent. The food production of the country is entirely rural. The productive labour of the country is mostly supplied from the rural areas. Raw materials like cotton, plantation crops, and even the fruits and vegetables are produced in villages.

But the disparity between the villages and the urban centres, in wealth, development and amenities for civilized life is very wide indeed. The urban citizen has clean drinking water, excellent roads and road transport, shops providing unadulterated foods at fair prices, education for his children, medical facilities, sanitation and recreational opportunities, while all these are non-existent for the villager. No doubt, the several five year plans have tried to level this difference by providing more opportunities for village development, educational programmes, rural electrification and many other measures. Even as early as the second plan, the Khadi and Village Industries Commission was set up to ameliorate these conditions. But the progress has been very slow and the conditions in most of the present-day villages are no better than what they were a decade or two ago[1].

The reason for this disparity can be traced to a large extent to the colonial system of economy. By and large the villages are the suppliers of the raw materials for urban development. Wealth flows from the villages to the urban areas. The comfort of the urban citizen is looked after by all the agencies and the

villages are the means to provide this. The best of staple grains are exported to the city while the village retains the second best. Milk is poured into the City dairies while the village children do not get even sufficient for minimum nutritional standards. Fruits and vegetables are grown in the villages and the city dweller gets them. The role of the villager is to produce these and supply them to the urban centres. The money he earns by this means either pays for the debts he has incurred for the cultivation of previous crop or is garnered for meeting the expenses on marriages, child births and funerals. The problem of rural poverty is proverbial and defies easy solution.

The children in rural areas are economic units, unlike the urban children who are non-productive capital till their late teens or early twenties. A rural child earns its living even from childhood. An eight year old girl tends a buffalo, the boy helps his father in the field. Thus education of village children is considered a non-economic pursuit. Consequently the children can only follow their fathers' professions. The chances that the city child has for improvement of economic status are nonavailable to the village child.

One of the many attempts to overcome this cycle of underdevelopment is to initiate technological development in rural areas, by reversing the flow of raw materials from the villages to the cities; setting up of small scale industries in the villages will ensure export of processed or semi-processed goods to the urban centres. This process is particularly suitable in the case of food industries where the capital cost could be contained.

The advantages of setting up food processing units in rural areas are multidimensional (*a*) stabilization of the price of perishable raw material — the processed foods have a much better shelf life than the raw material (*b*) retention of the overall profit in the rural areas — which could be used for overall development of the area (*c*) utilization of the unemployed and the under-employed man power of the villages — this has educational value in enlarging the skills of the village people (*d*) indirectly helping in the overall improvement — better medical facilities, better living conditions,

better education, health services, nutritional education, etc., (e) indirectly help the urban centres also by decentralization and limiting pollution.

The present paper has been prepared against this background, with the objective of discussing the feasibility of setting up a few cottage industries in villages.

CONSTRAINTS IN SETTING UP OF FOOD INDUSTRIES IN RURAL AREAS

Location: Not all villages are suitable for locating food industries. Certain minimum facilities should be available before any such venture is undertaken. A fairly good supply of water, either from a river or underground source, is necessary; similarly, sufficient open land, slightly away from the village is needed. The cooperation and good will of the local people is an essential requisite. The unit could be set up to cover several villages. Even small towns adjoining several villages could serve the purpose. Though it is not a necessary condition, a nearby rail connection will help the transport of goods. Similarly a motorable road adjacent to the factory is a great help.

Raw Materials: Before any food industry is located in a rural setting, the availability of raw materials, *i.e.,* cereals, oil seeds, fruits, milk, etc., has to be established. Most villages having good agricultural production are suitable for starting mini-rice mills, parboiling units, pulse processing units, or for processing units for oil or edible oil-seed cakes for nutritious foods like Energy food. Vegetable and fruit processing could be set up in some villages. Mangoes, citrus and tomatoes are grown in and around many villages. Banana products are reported to have a good export market[2]. Milk can be processed for local consumption as well as for products.

Equipment: The equipment generally available for food processing are designed to have capacities which are too large for the cottage or small scale industry. The choice of equipment is very critical as unmatched components always give rise to bottle-

necks or idling of the units, resulting in heavy overheads. Certain units may have to be fabricated to suit the capacities of the other units. Batch processes are better suited than continuous production units. Labour intensive operations are preferable, provided they do not interfere with sanitary requirements. In the food industry, stainless steel is the material of choice for equipment. But it is very costly and in some cases has to be imported. A decade or two earlier, many dairy factories on the continent and elsewhere were using butter churns made of wood. These had large capacities and were very good for the purpose. Most of these have now been replaced by stainless steel ones. There is no reason why for rural development, units made of wood or of other suitable metals should not be used in place of stainless steel. Such innovations are necessary to reduce the capital cost. Research and improvisation are urgently needed to replace stainless steel in small scale food processing units.

Technical know-how and entrepreneurship: It is in this field that research institutes, scientific organizations like the Association of Food Scientists and Technologists (India), universities which have adopted villages and private consultacy services can help. This is an aspect which cannot be left to emanate from the villages. The scientists have to contribute freely for this. Enough talent and enterprise are available in all these organizations to foster rural projects and it only needs motivation and catalysis to canalize these for the required objective. The government, banks and development cooperatives can provide this. The enterpreneurship has to be vested with a cooperative body, consisting of the members of the village council, representatives of the financing organization, scientists and engineers. The units are to be headed by qualified persons with dedication to make them a success. Naturally they have to be paid well to make the contribution successful. Even in this the sponsoring organizations can help.

Man power: One of the objectives in setting up rural industries is to gainfully employ the unemployed and underemployed labourers. The problems of training these for handling mechanical equipment is not difficult. But along with this a sense of hygiene and sanitation will need to be inculcated in the labour.

Ancillary services: One of the chief reasons why industries congregate in big towns, is the easy availability of ancillary services. Any break-down in equipment can easily be set right in big towns, while even in small towns this may not be possible immediately, with consequent loss in persishable goods. This difficulty becomes much more acute in villages. The only answer to this is to set up units with simple equipment. Adequate stores of spare parts have to be maintained and local mechanics have to be trained in maintenance of equipment.

Services: The services required for conversion of raw materials to the finished product are (*a*) electricity, (*b*) diesel oil, (*c*) steam and (*d*) water. All these are available in the villages where these industries are to be located. Steam can be generated by boilers of suitable capacity. Gobar gas where available could be used for boilers supplemented, if necessary, with an oil-fired unit.

Transport: Concentration of production units in urban centres has the advantage that the cities are well connected by transport systems. This is of great importance when the volume of goods produced is large. In rural units, the volume is small. Since the raw materials are produced in the villages, transport is required only for the despatch of the finished products. The cheapest type of transport available in rural areas is the bullock-cart. To what extent this can be used along with other dieselized transport is a matter for careful consideration.

FOOD TECHNOLOGY IN OPERATION

Transfer of Technology: International agencies of the United Nations have discussed "transfer of technology" and "intermediate technology" for developing countries. It has been emphasised that in selection of technology suitable for a particular country, the economics of it or rather the waste/benefit ratio of the technology to the country should be carefully assessed[3]. As far as India is concerned, the need for transfer of food technology from developed countries is minimal. On the other hand, there appears to be an urgent need for transfer of food technology to the rural and underdeveloped areas of the country from the urban scientific

community. Again here the mistake of transferring technology which the rural areas cannot assimilate, should be avoided. An area which has the potential to produce immediate results, is post-harvest technology. The losses of grain due to mishandling immediately after harvest and subsequent storage and processing have cost the country very heavily. Imparting the know-how of prevention of this, to the agriculturists in the villages, has been one of the major recommendations of a symposium held recently in Bangalore[4]. By up-dating the many rice mills distributed throughout the country and providing facilities for proper storage of grain at the village level, enormous savings in the food losses could be achieved. What is required for this, possibly even more than equipment, is taking the available knowledge to the rural areas, and making it work. We need for it "grass-root technologists" who are to be the intermediaries between the institutes of research, whether nutritional or technological and the villages where food is produced[5]. The functions of these are diverse—establishing contacts at both ends, carrying the message of the technologists to the field, and bringing back the difficulties at the operation centre to the institutes of knowledge and spreading the message of hygiene, sanitation and good housekeeping to the village food manufacturer. One of the essentials in this linking is the training of these grass-root technologists. It is a difficult task but should be undertaken by universities, and research institutes which are sponsoring projects in villages. The Association of Food Scientists and Technologists (India) can help in this training programme in a large manner through its regional sections and chapters. A dialogue between the Association and the Institutes and Universities should be started immediately to decide how best the tasks could be achieved.

With the above background, certain small scale industries which can be set up at rural centres have been listed in the annexure. Only the capital outlay on essential equipment has been indicated. This has been based as far as possible on recent quotations. No attempt has been made to include the cost of raw materials, services, labour and overheads as these variables dependent on location and on other factors. The choice of equipment for rural technology has been chiefly based on the one over-riding consideration that the equipment should be simple, easy to operate and at the

same time provide for hygienic handling of food. The decision regarding the most suitable units for a particular locality can be made after a complete assessment of all the factors stated above.

CONCLUSION

An important strategy in overcoming the inequalities between urban and rural areas of the country, and for providing a more balanced and comfortable life to the food producers of the country, is to set up food processing industries in the villages. Traditionally, processing of Jaggery (*Gud*) brown sugar, *sago* and a few other industries are village based. But in most cases they are devoid of modern technology and are run on unhygienic practices. Modernizing these and introducing new food-processing units to the village are tasks which the scientists and organizers of projects for "adoption of villages" should take up immediately.

The programmes of the Social Welfare Departments to combat malnutrition in pre-school and school children require supply of the right type of food. The production of this could be decentralized and the villages or a group of villages could produce this food sufficient for the use of the group. The capital cost and the distribution cost could thus be minimized. The formulations could also be varied depending on the available raw material and taste preferences of the population concerned.

Units for the preparation of edible oil seed meals (groundnut and sesame), fruit products, Indian Milk Sweets, biscuits, *papads* and other snacks could be set up in the rural sector. Know-how for all these is available and it has only to be translated into working units. In doing so, strict adherence to nutritional and hygienic standards is absolutely necessary.

APPENDIX

Approximate cost of equipment for units

		Rs.
1.	Paraboiling unit including driers ..	1,25,000
2.	Edible groundnut flour (4 tonnes/day) ..	81,400

3.	Units for Nutrition units for Social feeding programmes (*Bal Ahar*, Energy Food, etc.) (1 tonne/day)	50,000
4.	Fruit Processing Units (1/2 to 1 tonne/day) ..	1,10,000
5.	Biscuit Production Unit ..	1,20,000
6.	Snacks, *Papads*, Dry Fruit, Paste Foods ..	40,000
7.	Miltone, Vegetable Milks, Indian Milk, Sweets or Milk Processing ..	2,00,000

[A boiler is needed for most of these units. Whether gobar gas could be used for raising steam or for hot air ovens, for drying, etc., could be investigated].

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RURAL HEALTH PROBLEMS

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All over the world in the developing countries the problems of rural health have the same basic pattern. In these countries nearly 80 per cent of the population are in the rural areas. But 80 per cent of the doctors live in urban areas and look after the 20 per cent of the population. The money that is available for health and medical work is limited when compared to the resources of the developed countries. Even this small amount of money is spent on capital-intensive projects like construction of massive buildings, providing sophisticated instruments, etc., These equipment and buildings can take care of the illnesses of a few people, while the vast majority of the population do not get their basic needs satisfied. In the last few years a large number of people have pointed to the lop-sided system of medical relief in the developing countries. As a result of this there is a considerable thinking now as to how the maximum number of people of a country can have basic health needs satisfied with the available resources.

PROBLEM OF RURAL HEALTH

In India we are producing 12,000 doctors a year and the ratio is one doctor for every 3500 people in the country. But in the rural areas there is one doctor for every 30,000 people while in urban areas like Madras we have one eye doctor for every 600–700 population. The available hospital beds in the country are in the ratio of one bed for every 2000 population. But in rural areas, there is one bed for every 15,000 population while in the urban cities, there is one bed for every 500 population. We know that the bulk of the infectious diseases like typhoid, diarrhoea, cholera, dysentry, etc., can be prevented by providing clean drinking water, proper drainage and good sanitation. The Government

of Tamil Nadu is trying to provide proper drinking water for rural areas; but toilets and good drainage are still scarce. As a result, diseases like diarrhoea, dysentry, typhoid, etc., are still common all over the country. These diseases affect the children of younger age, resulting in high mortality. The infant mortality rate for children below 1 year is more than 100. The mortality of children between the age of 1 and 5 also is very high. Nearly 20 to 25 per cent of the children die before the age of 5. As we are not able to guarantee survival of the children, people are anxious to have more children so that at least some will survive, to look after them in their old age.

Even among most of the surviving children, 15 to 20 per cent are grossly malnourished. These children have very little resistance and they get diseases like diarrhoea, fever, etc. In a year, these children with gross malnutrition are acutely ill for more than 100 days. This causes great economic and physical strain on the parents.

More than want of food or money, ignorance is mainly responsible for the poor nutrition and health of our children. People spend a lot of money on magic cures, quack remedies, talismans, etc. If we can educate our people, as the farmers are being educated, about the uses of fertilizers and pesticides, we can change the situation in a very short time. People are aware of the different types of fertilizers, the methods of use, etc. But they do not know what supplementary foods can be given for a child. People are told day in and day out about use of pests and pesticides, but they do not know how to treat intestinal worms in a small child. If we can provide for this educational convenience to the people by proper demonstrtaion, the position can be changed very rapidly. Want of proper nutrition in small children not only affects physical growth, but also affects proper development of the brain. This is a very important factor which our Finance Minister has stressed repeatedly. No nation can be developed unless its people have proper physical and mental growth. Countries like Japan, in spite of their lack of natural resources, have developed immensely because of their excellent man-power.

The poor physical and mental growth affects the education of our children. Poor understanding of lessons is due to want of proper mental development. We know that only 20 per cent of the children who join in schools are able to finish five or six years of schooling. This is a great economic loss. Whether he is a farmer or a craftsman, we want him to think in a rational way and do work efficiently. People are illiterate and they are not able to achieve efficiency in their work. They do repetitive things and they have no capacity for organisation. Amongst our school-children, 25 to 30 per cent have vitamin deficiencies. Their growth is not up to the mark and their performance in sports is poor. Nearly 1 per cent of our children have got leprosy, 1 per cent have got tuberculosis, and 10 to 15 per cent need spectacles. Proper nutrition and proper school health examination with treatment, can cure leprosy and tuberculosis at this stage.

WORKING AGE

There is considerable variation in the working capacity of the people in the different parts of Tamil Nadu and different parts of India. A farm worker in Coimbatore can do more manual work than a farm worker in Tanjore or South Arcot. To some extent this depends upon the amount of food eaten. The average intake of food per person in Tamil Nadu is about 1500 calories while the average intake of food in Punjab is about 2000 calories. So the Punjabi worker can do more sustained hard manual work than the Tamilian worker. The Indian worker has to support more people than a western worker, who does not have so many dependants, e.g., 4–5 children, dependent, disabled parents, relatives, etc. This also affects the working efficiency of the person. In our villages, 30 years earlier, the worker was provided with a midday meal, which was substantial in quality and quantity and he used to work hard. After the farmer's wives stopped the midday meal, the working efficiency of our labourers has gone down. Long back, when slavery was common, a master was advised to feed the slave with a good amount of meat and corn. In practice they found out that well-fed slaves can work better than poorly fed slaves. A good farmer takes care of his bullocks properly so that their working efficiency will be good.

DURATION OF WORK

Proper maintenance of health increases the life span of the people in developed countries. The expectancy of life in India is 53 years while that of a Japanese is 74 years; he is able to live for 20 years more and to contribute his efforts to the country. People in the developed countries: factory workers, and Government servants, retire at the age of 65 years while in India the retirement age is 55. So every person contributes more not only in terms of the amount of work he does per day but also the number of years he works in his life. 1.5 per cent of our population have got acute Tuberculosis. There is another 1.5 per cent who have got quiescent Tuberculosis. Not only does it affect the working efficiency of people but these people are a source of danger to others as it is a communicable disease. Tamil Nadu has got about 7 to 8 lakhs of people with leprosy. Other diseases, like anaemia and hook-worms, affects the working efficiency of the people in the rural areas considerably. Even a mild illness or a small injury is not attended to early and this causes considerable amount of suffering. The man loses his earnings.

A high percentage of our pregnant women are anaemic. The mortality rate is also high, for every 1,000 women delivering 3 die, while only one in 10,000 dies in England. Even now, a large number of deliveries are conducted by unqualified people. Lack of proper sterilisation of the knife used to cut the umbilical cord, is responsible for tetanus. We still see in some villages, many children dying by tetanus every year. These children die before the 10th day after birth. If you can educate the people about these simple matters, a lot of hardship can be prevented. In the rural areas, simple diseases like cataract cause blindness and people get disabled. The person cannot earn his livelihood but has to depend upon somebody else. In developed countries people do not allow the cataract to cause blindness; they get operated on quite early. Nearly 1.5 per cent of the people in villages are blind due to cataract. In the same way, other diseases like arthritis and defective hearing affect the efficiency of our workers.

THE THREE-TIER SYSTEM OF HEALTH DELIVERY IN RURAL AREAS

In this system it is proposed to train the community level

workers on basic health problems. In agriculture, the young farmers are being trained. In the same way, village school-teachers, village women and youth can be easily trained about nutrition, common diseases and their treatment. For the green revolution, it was important to get the farmers involved in scientific farming.

In the same way, community health involves participation by people. It is not a commodity like electricity which can be generated and distributed to all. Every individual must participate, to prevent diseases, obtain good nutrition, and take care of his body. Our people are capable of doing this. We have worked in villages in 3 community blocks. We are training the mothers on scientific methods of feeding children, and treating common diseases. We must take scientific knowledge right down to villages. In this way, medical treatment has to follow like what has been done in agriculture. We use the radio, exhibitions, hoardings, posters, etc., to spread the scientific knowledge to improve agriculture. In the same way our target here is to educate every person in the society on the proper care of his body. Next in line will be a health worker or a multipurpose worker. These people will be auxiliary nurses or malaria eradication workers. They will have more training, they can diagnose simple diseases and treat them, they can refer complicated cases to the Primary Health Centres (P.H.Cs.) Above the health worker there will be a Health Supervisor, who will be better qualified. In addition, for community progress we need all the following for prevention of diseases: immunisation, proper environmental sanitation and nutrition, water supply, etc. At the top of the block there are Primary Health Centre Doctors. So the whole group will work as a team.

In addition, as you have in this seminar an integrated approach utilising the different branches of science: the agriculturist, the poultry expert, the dairy expert and the fisheries expert can join together and produce enough food for the community in a block or a village. If we use all scientific knowledge available we can solve these problems. The Engineering Department will help us to provide drinking water, proper drainage, toilets, good housing, etc. The Education Department can help by improving communi-

cation of knowledge, which is a basic need for developing the community. The Medical Department will keep the man-power in good shape and assure the people freedom from infection.

COMMUNITY HEALTH CARE BY MEDICAL COLLEGES

The Government of India is eager now that medical colleges should take up adoption of the whole district and maintain its health in proper condition, as has been done by the Agriculture Department: the Regional Director of Agriculture has got a separate team for training and propaganda. He has teams to deliver fertilisers and pesticides. In this way you are able to achieve a target in our production of food. In the same way medical colleges which have got a great store of trained medical personnel, can look after the whole area and see that the man-power is kept in good shape.

INTEGRATED DEVELOPMENT OF RURAL AREAS

I am extremely happy that our Finance Minister has suggested a project for the integrated development of rural areas and our Prime Minister has stressed this. Our scientists, and the University Staff have started thinking about it and the Agriculture Department has already been working on it and has succeeded in its attempt. In Tamil Nadu, in the last 4 years, organised eye camps for the benefit of Rural people have been held. Over 1,20,000 cataract operations have been carried out in these eye camps. In the whole world, this is the biggest eye relief project. In the last 3 years, we have been working in 3 community blocks near Madurai. We have found that the village mother, properly guided, can become as capable as a mother in any developed country. They improve the nutrition of the children. They are able to treat common illnesses, they want an immunisation programme for the children, and the efficiency of their homes has improved considerably. The home economists, the nutritionists, and the medical people have all worked together for this. Mainland China has organised a good Preventive Health Programme. In the oil-producing countries you will see that with enormous amounts of money they are trying to build up better houses and improve

their health. If India could achieve this in the next 10 years it will be a great lesson for all developing countries. What we have done can easily be followed by other countries in Africa, South America and Asia.

WATER RESOURCES FOR RURAL AREAS:

SCIENTIFIC SURVEYS AND PROGRAMMES

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INTRODUCTION

In the Biblical concept, the very origin of life is related to watery beginnings. History is replete with instances where many civilisations thrived or perished depending on the availability and utilisation of water resources, mainly along the flood plains or close to major river courses. Even in the present global system, water is one of the principal elements which not only governs life on earth but also influences the economic, industrial and agricultural growth of mankind.

The cycle of activities of water extend through three parts of the earth's system, namely, the lithosphere, the hydrosphere and the atmosphere. The shallow life layer of planet earth (Biosphere) is close to the vital interfaces between the basic earth realms indicated above. As such, the impact of man on the environment and vice versa is more important in the atmo- (air) and hydro- (water) spheres. In view of this, the environmental stresses related to the water realm need to be considered in the overall perspective while planning the water resources development for rural or urban areas.

In presenting the text of the paper, the author has tried to focus attention on the scientific surveys and programmes normally considered useful for locating water resources for rural community water supply needs especially in scarcity areas. The survey is also aimed at locating sources of water for supplementary irrigation and allied needs which promote rural development. An indication has also been given on the long-term programmes

for rural development with bias on water resources aspects. In essence, the long-term programme is to provide protected water supplies to the rural community and also for stock purposes as well as to enhance the minor irrigation programmes which have a direct bearing on the utilisation of surface and ground waters for agricultural needs. The presentation of the material is based on the programmes being carried out essentially in India, though the experiences of other countries is also taken into account.

SCIENTIFIC SURVEYS FOR RURAL WATER SUPPLIES

As it is a basic pre-requisite to assess the ground water regime in the country on a regional scale and provide information on the availability of ground water in different areas/rock formations, the Central Ground Water Board (Ministry of Agriculture and Irrigation) of the Government of India carries the responsibility for conducting hydrogeological surveys all over the country. This technical information is useful for projecting schemes for water supply needs both in the urban and rural areas. In recent years, these programmes have been mainly directed, on priority, in the water scarcity areas of the country. In India, nearly 2.6 million sq.km. (excluding very high, hilly areas) needs to be hydrogeologically surveyed. Till now, the Central Agency (CGWB) has covered an area of about 1.4 million sq.km. The remaining area will be covered in the next few years.

In India, major population settlements are in rural surroundings. The sanitation conditions in the villages in general create many problems in regard to pollution of water (both surface and underground waters). Hydrogeological surveys carried out under the drought relief programme have revealed that the village waste-disposal sites are the main point sources to contaminate the ground water and, at times, even the surface water sources. In locating wells under community and rural water supply programmes, these source points of contamination may be avoided and well sites may preferably be located on the higher elevations of the village limits and away from such sources of contamination as far as possible. As many geographical areas in the country are subjected to persistent economic and social stresses due to

drought, the study of rural water supplies and associated environmental aspects assumes special significance. This also applies to other developing countries where emphasis has been given for rural water supply needs for smaller communities. Experience has shown that there is need to put on ground geotechnical programmes to bring out utilitarian maps depicting natural environmental potential for the rural surroundings so that on a long-term basis the water resources on a regional and local scale may be protected from any contamination/pollution especially when its use is directed towards human consumption.

Many of the professional men in the fields of public health engineering, hydrogeology and medicine are aware that there should be a proper level of fluoride concentration in drinking water supplies. The disease known as "Fluorosis" arises primarily due to excess of fluoride in drinking waters. Human beings as well as livestock are seriously afflicted and even crippled by this disease. Recent hydrogeological surveys conducted in the country have revealed that fluoride concentration is the highest (detrimental from the health hazard point of view) in the arid and semi-arid belts of Western India and is also of moderately high order in the semi-arid tracts of South India. Many villages and towns in these geographical regions demand careful attention on the long-term impact of such drinking water sources on human health especially in the rural areas where the nutritional value of the food intake of the population is not of a high standard. Most of the tropical and sub-tropical countries should need to look into this aspect also with enough care while locating the sources (both surface and ground water) for water supply needs. The surveys carried out by the author on a short-term basis in Sri Lanka also substantiate this conclusion.

It may be added that there are many conventional water supply systems in vogue. These include open wells fitted with pumps, dug-cum-bored wells, filterpoint wells, bored wells/tube-wells, infiltration galleries and collector/radial wells, etc. Some of the techniques hitherto adopted for construction of the water supply systems especially in regard to bored wells may have to be considered as outdated in view of the advancement in technology.

Faster drilling techniques have been achieved through down-the-hole hammer type rigs in the hard rock terrains covering mainly the Peninsular Shield area of the Indian Sub-continent. Some of the developing countries may have to benefit from the experience gained in India on such programmes (bored wells for water supply needs in the villages) and shift their emphasis to faster drilling techniques especially under emergency water supply programmes.

It is also suggested that the areas earmarked for rural development in all facets including water resources aspects should, on a long-term basis, be subjected to scientific investigations which may facilitate artificial recharge to ground water reservoirs, water harnessing techniques on small catchments, adoptation of soil moisture conservation methods and allied feasibility studies which may enhance the judicious use of water for development purposes. Also, basin-wise (drainage basin-wise) water balance studies and watershed management programmes may be undertaken for scientific assessment and utilisation of the resource.

MINOR IRRIGATION PROGRAMMES FOR RURAL DEVELOPMENT

Under minor irrigation programmes, the surface water resources are usually tapped by three types of irrigation systems/ structures. These include storage resrvoirs and tanks which impound stream-flow for irrigation purposes, diversion schemes which facilitate diversion of stream-flow without arranging any storage (weir construction across the streams) and lift irrigation schemes which permit direct pumpage from rivers, streams, lakes, etc. The ground water extraction structures under the minor irrigation programme include wells and dug-cum-bored wells with lifting appliances and shallow and deep tubewells (private and State-owned). The chief value of ground water as a source of irrigation has attained special significance in India in the last decade as it has been recognised, in fact, as the farmers' own programme, as most of the ground water extraction structures are owned, operated and maintained by the cultivators themselves. This has a special significance for the rural economy and rural development. Recognising the popularity and usefulness of the programme in increasing agricultural production, concerted efforts

are being made at the Central and State levels to accelerate its implementation to the maximum extent possible. It may be added that the contribution of ground water to total irrigation in the country is now as high as 40 per cent.

In the above context, the possible approach to rural development with bias on water resources should be to attempt an integrated resources inventory with a view to identify unexploited or under-exploited water resource potential which can provide a basis for further action plans on minor irrigation schemes. This would ensure, in a positive way, development in the rural economy. Such schemes would also help small and marginal farmers with limited land holdings, to have their own assured sources of water supply especially during the seasonal vagaries in rainfall.

LONG-TERM PROGRAMMES FOR RURAL DEVELOPMENT—WATER RESOURCES ASPECTS

The drought prone areas programme (DPAP) initiated by the Government of India in 1970–71, aims at mitigation of the effects of drought through integrated area development programmes in three distinct rainfall categories namely arid (upto 375 mm), semi-arid (376 to 750 mm) and sub-humid (751 to 1125 mm). Nearly 72 districts have been selected for assistance under this programme covering about 600,000 sq.km. and a population of about 66 million. The programme aims at providing permanent employment, on-farm development and improving public sector services. Of late, six districts were chosen under the IDA Programme to intensify the activities on public works with emphasis on minor irrigation, command area development, water-shed management, dry farming and allied productive programmes and investments. The minor irrigation component takes into account the ground water resources development aspect also by way of sinking wells and tubewells backed up by semi-detailed ground water surveys for the project districts. Energisation of wells with pumpsets is also considered under the programme. This programme in conjunction with the water-shed management programme would reduce the excessive run-off now taking place in some of the drought-prone areas as a result of poor cultivation

practices, over-grazing, fuel-wood cutting and denudation of land and soils. The programmes associated with the water realm, if implemented on scientific lines, would help to increase the ground water recharge also. In the overall strategy for implementation of the DPAP programmes, the provision of drinking water supply is also accommodated. For this purpose, plans are based on ground water resource potential of individual districts.

In order to extend the benefits of integrated development to selected tribal areas, the Government of India initiated a programme, in the early seventies, which is now termed as the "Integrated Tribal Development Areas" (ITDA) programme. In about 97 districts of the country, groups of villages/areas have been identified and demarcated for such development. The development plans also take into account provision for water supply and irrigation facilities both from surface and ground water resources. Programmes in this direction are being taken up on priority during the current Plan period (1974–79).

An action plan for "Integrated Rural Development" by adopting nearly 19 districts in the country has been formulated by the Union Ministry of Agriculture and Irrigation and is being implemented by the Indian Council of Agricultural Research (ICAR). Under this programme, integrated resources inventory is also planned, covering the water resources aspects.

With the implementation of the large-scale ground water exploitation programme in the country for multi-variate purposes, the requisite power grid is being extended into the rural areas under the Rural Electrification Corporation (REC) Schemes. The availability of requisite power in the interior areas to match with the number of pumpsets being installed on wells for exploitation of ground water resource for agricultural and allied needs has been ensured through such programmes. A large number of viable schemes have been sanctioned by the REC in the rural areas after ascertaining the availability of ground water resource for such purposes on a long-term basis.

The Ministry of Health in collaboration with the State Governments (Panchayati Raj and Public Works Departments) and

UNICEF initiated a massive programme during the Fourth Plan period (1969–74) for village water supply needs. The programme is directed mainly towards the supply of drinking water sources to the village community in various parts of the country by drilling bored wells and tubewells, suitably supported by geophysical and hydrogeological surveys in selective regions.

Many of the long-term programmes in the country directed towards rural development with provision for water resources development also (both surface and ground waters), have attracted the attention of the international agencies such as IBRD/IDA, UNDP, UNICEF, etc. In recent years, WHO and ADB have also shown interest in major community water supply programmes especially in the South-East Asian Region.

SUM-UP

In dealing with the subject "Water Resources for Rural Areas", the author has briefly presented the scientific surveys and programmes being implemented in this regard in the country. The basic considerations and objectives associated with such programmes are also elucidated. Many facets associated with scientific surveys for rural water supply needs, such as hydrogeological surveys for resource identification, environmental and health hazard problems associated with drinking water sources and recent trends in the construction of water supply systems, have been touched upon. A brief account of the minor irrigation programmes for rural development has also been presented. The long-term programmes for rural development planned and being executed by the appropriate authorities in the country with a bias on water resources aspects, have also been indicated with a view to give an idea of the magnitude and multi-variate nature of the problem. It has been stressed that these programmes with scientific and technological orientation would also subscribe towards the concept of integrated rural development, when completed in the desired manner.

RURAL DEVELOPMENT EXPERIENCE IN OTHER SOUTH—ASIAN COUNTRIES

Besides India, participants from several other developing countries in the South-Asian region attended the Seminar. Some of these participants also presented papers on rural development programmes and experiences in their countries. These papers bring out the wide range of problems encountered in rural development. The various scientific and technical methods adopted by the administrators, scientists, technologists and educators in these countries to tackle the problems of rural development, have been described. Some pointers for planning future rural development programmes in these countries are presented and may serve to give an indication about the directions which development programmes in other South and South-East Asian countries could usefully follow.

RURAL DEVELOPMENT IN MALAYSIA

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Since its independence in 1957, Malaysia has embarked on a series of impressive Five-year Development Plans for the social and economic development of the country. The overall goals of these development plans (the New Economic Policy) are summarised below:

(i) employment creation at a rate sufficient to reduce current levels of unemployment (7 per cent) and eventually bring about full employment of the labour force

(ii) expansion of the income and productivity of all those engaged in low productivity rural and urban occupations by increasing their access to opportunities for acquiring skills, land, capital and other necessary inputs and by eliminating underemployment

(iii) enlargement of opportunities for those engaged in low productivity occupations to move to more productive endeavours in agriculture, forestry, fisheries, mining, construction, transportation, manufacturing, commerce and service industries

(iv) reduction of existing inequalities in the distribution of income between income–and racial groups

(v) modernization of rural life and improvement of living conditions among the urban poor through the provision of a wide range of social services including public housing, electricity, water supply, sanitation, transportation, health and medical services and recreational and community facilities

(vi) creation of a commercial and industrial community among the Malays and other indigenous people in order that, within one generation, they will own and manage at

least 30 per cent of the total commercial and industrial activities of the country in all categories and scales of operation

(vii) restructuring of sectoral and occupational employment patterns in the various sectors of the economy so that they reflect the racial composition of the country by 1980, and

(viii) expansion of education and training facilities, other social services and the physical infrastructure of the country to effectively support the attainment of the above objectives.

Development targets for 1971–1990 are summarised in Table 1.

TABLE 1

Malaysia: Development Targets 1970–1990

	1970	1975	1990	Average annual growth rate 1971-75	1971-90
GDP ($ million in 1970 prices)	10,708	15,315	50,097	7.4	8.0
GNP ($ million in 1970 prices)	12,155	17,146	55,069	7.1	7.8
Employment	—	—	—	3.3	3.3
Unemployment (%)	7.4	7.0	3.6	—	—
Value added per worker[a] ($ in 1970 prices)	3,376	4,078	8,241	3.9	4.6

[a] for Peninsular Malaysia

The twenty years since Independence has seen the successful completion of four Five-Year Development Plans in Peninsular

Malaysia and two in Sabah and Sarawak. The Gross Domestic Product of the country has grown by over 6 per cent per annum in real terms. While the population grew by over 30 per cent in the sixities, the size of the economy almost doubled, thus increasing per capita income by some 40 per cent over the period. Some major output indicators to show the improvement in health and education during this period are given in Table 2.

TABLE 2

Malaysia: Socio-Economic Indicators

	1957	1970
Infant mortality rate (per 1,000)	75.7	40.8
Male life expectancy (years)	56	64
Female life expectancy (years)	58	68
Literacy rate (10 years & above) (%)	51.0	60.8
Enrolment in schools (%) (5–19 years age group)	49.8	52.7
Government expenditure on education per capita	$ 21	$ 45

Some 22 per cent of total development expenditure by the public sector has been aimed at increasing the income earning capacity and quality of life of the rural poor through rural development. The major programmes included new land development, rubber replanting, and drainage and irrigation to enable double-cropping of *padi*, as well as the improvement of social and community services in the rural areas. Real output in smallholder agriculture registered an annual growth of about 6 per cent over the period 1961–70.

However while significant progress has been made to eradicate poverty, in Peninsular Malaysia, about 835,000 (43.9 per cent) of the 1.9 million households still realized incomes at or below the poverty line in 1975. Of these, the incidence of poverty was 54 per cent among rural households compared to 19 per cent among urban households (Table 3).

TABLE 3

Peninsular Malaysia: Poor Households[b]

	1970	1975	1990 target
Poor households ('000)			
Rural	706	730	389
Urban	86	105	125
Incidence of poverty (%)			
Rural	59	54	23
Urban	21	19	9
Percentage among poor			
Rural	89	87	76
Urban	11	13	24

[b] The poverty line income employed to distinguish poor households from other households is a monthly income that is necessary to cover minimum nutritional requirements and essential non-food expenses to sustain a decent standard of living.

One of the major objectives in the Third Malaysia Plan (TMP), 1976–1980, is the eradication of poverty particularly in the rural areas among *padi* cultivators, rubber smallholders, coconut smallholders, shifting cultivators, fishermen, estate workers, residents of New Villages, agricultural labourers and the *Orang Asli* by:

(i) expanding employment opportunities through new land development, establishment of new growth centres and the absorption of excess labour in other sectors of the economy

(ii) enhancing the productive role of the rural poor by increasing their access to land, water supplies, credit, markets, extension advice and other public facilities including electric power.

Another major objective in the TMP is to enhance the quality of life of all Malaysians and in particular the poor, through the expansion of education, health services, family planning facilities and housing.

The rural development programme in Malaysia has consisted of two parts:

(i) the provision of physical amenities such as public wells, medical centres and rural roads, and

(ii) comprehensive land development schemes to provide land for the landless.

The development of extensive physical amenities in the rural areas has enhanced the quality of life and living standards among the rural communities.

RURAL HEALTH SERVICES

The rural health services have been aimed at providing a comprehensive preventive and curative service to the rural population. The development of rural health facilities in Peninsular Malaysia is summarised in Table 4.

TABLE 4

Peninsular Malaysia: Development of Rural Health Facilities.

	Main Health Centre	Health Sub-Centre	Midwives Clinic-cum-quarters
First Malaya Plan (1956–60)	8	7	25
Second Malaya Plan (1961–65)	31	115	618
First Malaysian Plan (FMP) (1966–70)	5	58	300
Second Malaysian Plan (SMP) (1971–75)	29	66	339
Total (1956–75)	73	246	1,282
Population per facility	94,571	28,063	4,312

In Sabah, the rural health services are based on a two-tier system of rural dispensaries and village group sub-centres. Rural dispensaries are provided with beds and in some places maternal and child health facilities. Four rural dispensaries and 66 village group sub-centres were built in the SMP period.

In Sarawak, the rural health services are organized in a two-tier system of one main health centre and four health sub-centres to serve a population of 25,000. During the SMP period, community health centres serving a population of 2,000 each as well as travelling dispensaries and floating clinics were introduced. A total of 18 health sub-centres, 30 travelling dispensaries and two floating clinics were provided during 1971–75.

A rural environmental sanitation project was started in 1969 as a pilot project in 11 areas (one area per State in Peninsular Malaysia) covering a population of 30,000, to raise the standard of health of the rural population through improved sanitation by developing sanitary latrines and small community water supply systems on a *"gotong-royong"* basis. The public health inspectors and overseers at main health centres and health sub-centres provided the technical expertise for these programmes. In 1973, the project was expanded throughout the country and is designed to cover about 70 per cent of the rural population by 1980.

The satisfactory implementation of programmes for the control and eradication of communicable diseases such as malaria, tuberculosis, leprosy, filariasis, yaws and diphtheria has resulted in the rapid decline of these diseases among the rural population.

RURAL ELECTRIFICATION

The expansion of rural electrification in Peninsular Malaysia is shown in Table 5.

TABLE 5
Peninsular Malaysia: Rural Electrification

	No. of new rural households provided electricity
Second Malaya Plan (1961–65)	42,000
First Malaysia Plan (1966–70)	51,750
Second Malayisa Plan (1971–75)	33,100 (297 villages)

DRAINAGE & IRRIGATION

The improvement in drainage and irrigation facilities in Peninsular Malaysia is shown in Table 6.

TABLE 6
Peninsular Malaysia: Drainage and Irrigation

	Padi area brought under irrigation (acres)
Second Malaya Plan (1961–65)	113,000
First Malaysia Plan (1966–70)	202,000
Second Malaysia Plan (1971–75)	324,000

Of the 324,000 acres of *padi* land in Peninsular Malaysia which were improved through irrigation facilities in the SMP period, 272,000 acres were provided with double-cropping facilities. The Muda Irrigation Scheme was completed in 1974 and provided for 152,000 acres to be double-cropped (in addition to 83,000 acres under the FMP period).

Under the SMP, some 247,000 acres of swamp and existing agricultural land, mainly in Peninsular Malaysia, were improved through drainage facilities for the cultivation of crops other than *padi* including coconut, rubber and cocoa.

EDUCATION

One of the most significant programmes in the rural areas has been the rapid improvement in educational opportunities. By 1970, over 75 per cent of the 4,440 primary schools and about 50 per cent of the scecondary schools were in the rural areas.

An important feature of upper secondary education has been the establishment of 11 fully residential science schools, with a total enrolment capacity of 9,240, to provide expanded educational opportunities in science, mathematics and related subjects for pupils from rural areas. A further seven such schools are to be built under the TMP bringing the total enrolment to 15,120 students.

High rates of dropout have been identified among the poor, especially in the rural areas. Increasing efforts are being made to reduce dropout from the educational system at primary and secondary levels. This includes the progressive amalgamation of small schools, mostly in the rural areas, to enable more effective utilization of resources for improving the quality of education. Other programmes comprise remedial education for slow learners, implementation of the textbook loan scheme for poor pupils and health and nutrititional programmes.

LAND DEVELOPMENT

With Malaysia's abundance of both under-utilized labour and undeveloped land suitable for agriculture, along with extensive knowledge of perennial crop technology, land development provided the most obvious strategy for socio-economic development of the country. Land development has therefore received the largest single allocation of public development expenditure, with the aim of providing land to the increasing number of landless people, and of creating farms of economic size based on modern agricultural practices. Expenditure for land development in the different Malaysia Plans is given in Table 7.

TABLE 7

Malaysia: Public Sector Land Development Expenditure

	Expenditure
First Malaya Plan (1956–60)	$ 17 million
Second Malaya Plan (1961–65)	$ 130 million
First Malaysia Plan (1966–70)	$ 310 million
Second Malaysia Plan (1971–75)	$ 1139 million
Third Malaysia Plan (1976–80)	$ 2010 million

Several agencies in the public sector are involved in land development. The major types of land development schemes are:

* Federal Land Development Authority (Felda) Schemes, in which projects are planned and implemented by Felda, a specialised national agency. All development costs are fully financed, including expenditure on settlers' houses and on a sophisticated general management.

* Fringe Alienation Schemes, in which projects are established by individual State Governments to supplement the income of smallholders already farming uneconomic units in nearby areas. These schemes are partially financed with Federal funds, together with some subsidies by the State Governments.

* State Schemes, in which projects are established with either full or partial financing by the State Governments concerned. Certain State Schemes are patterned on those run by Felda, but neither the infrastructure nor management is so sophisticated.

* Unsubsidised Schemes, in which the projects have been financed almost entirely by the participants, only the alienation fees being advanced by the State Governments.

The four types of schemes described above accounted for about 92 per cent of the total land development acreage in 1970.

Details of Peninsular Malaysia land development schemes are shown in Table 8.

TABLE 8
Peninsular Malaysia Land Development Schemes (Dec. 1970)

Type of Schemes	No. of Schemes	Main Crop ('000 acres) Rubber	Oil Palm	Both
Felda	90	147.8	160.6	308.4
Fringe alienation	398	135.3	—	135.3
State	70	37.0	—	37.0
Other subsidised	141	66.7	14.4	81.1
Unsubsidised	391	229.0	0.6	229.6
TOTAL	1090	615.8	175.6	791.4

The progress made in the period 1971–75 and the targets for 1976–80 are shown in Table 9.

TABLE 9
Malaysia: Progress in Land Development, 1971–75, and Target Acreage, 1976–80 ('000 acres)

Agency/Programme	1971–75	1976–80 target
Federal Land Development Authority	412,375	350,000
Federal Land Consolidation and Rehabilitation Authority	58,255	50,000
Rural Industry Smallholders Development Authority	47,251	100,000
State programmes	355,544	240,000
Joint venture/private sector	137,144	260,000
TOTAL	1,010,569	1,000,000

Felda: Felda schemes involve the opening up of areas of land between 4,000 and 5,000 acres each. These areas are planted with rubber or oil palm and other amenities such as rural roads, water, dwellings, schools, health centres, drainage and irrigation, processing plants and road links with the main highways are all provided. Each scheme accomodates 400 families. If the main crop is rubber then each family is given 10 acres, 8 of which are planted with rubber and the rest with rice or fruit trees. In the case of oil palm, each family is provided with 12 acres, 10 of which are planted with the main crop. The detailed acreage distribution of a scheme for 400 families is shown in Table 10.

TABLE 10
Distribution of Acreage in Felda Schemes

	Rubber (acres)	Oil Palm (acres)
Main crop:		
Rubber at 8 acres/family	3,200	4,000
Oil Palm at 10 acres/family		
Subsidiary crop:		
Fruit trees or rice at 2 acres each	800	800
Central village with 400 quarter-acre house lots, shopping centre, reserves for public and social amenities, government purposes, processing facilities, etc.	200	200
TOTAL	4,200	5,000

The Felda Schemes are comprehensive and reduce the pressure on the existing farming areas, remove families intact from the rural areas, provide them with 'economic-sized' farms and create landowning farmers. The settler is expected to obtain a monthly income of about $ 400 from his main crop together with whatever he can obtain from the two acres of fruit trees or rice and from the cattle and poultry reared on his house-lot. As part of the

undertaking a maintenance stipend is granted until the main crop matures, after which the settler starts repaying the Felda loan by instalments. With the exception of ex-servicemen who are given top priority, settlers on these schemes are chosen on a point system in which age, family size, experience and land ownership form the main criteria.

In the first ten years of its operation, 1956–66, the Felda concentrated on schemes varying between 4,000 and 5,000 acres each. In 1966, it launched the massive 330,000 acres Jengka Triangle Project (1966–1977) which is being operated by individual small holders grouped into settlement units each growing a single crop. The Jengka Triangle Project is a precursor of a series of major land development schemes. The Johore Tenggara Project (370,000 acres) and Pahang Tenggara Project (2.5 million acres) are other massive land schemes which commenced in the Second Malaysia Plan period (1971–75).

By the end of 1973, Felda spent $ 676 million to develop 570,000 acres and settled 28,044 settler families, *i.e.,* $ 1186 per acre of land developed for agriculture and settlement or $ 24,105 per family settled and $ 14,700 per job created.

Felcra: The Federal Land Consolidation and Rehabilitation Authority (Felcra) which was established in 1966 is another major land development agency of the Government. Originally its main functions were to develop Fringe Schemes within communicating distance from existing settlements and to rehabilitate State Schemes which have failed. The main objective of the development was to supplement the uneconomic farm holdings of the rural peasants as a means to increase their earning capacity. Over the years, additional responsibilities have been entrusted to Felcra, including the establishment of Youth Land Schemes designed to combat rural unemployment and check the exodus of youth from the villages to the urban centres. As at the end of 1973, Felcra developed 30,500 acres of Fringe Schemes and 18,200 acres for youth and rehabilitated 23,500 acres. Its expenditure was $ 569 per acre developed or rehabilitated and $ 4675 per job created.

Risda: The Rubber Industry Smallholder Development Authority (Risda) which incorporates the former Rubber Industries (Replanting) Board, was established in 1973. It has the responsibility of replanting and block new planting with high yielding materials and advance materials to reduce immaturity period. The main purpose of the block new planting or the establishment of Risda estates is to provide rubber smallholders with additional acreage in the form of shares in the estates. This will give them an additional source of income from the estates and hence make it possible for them to replant their uneconomic old plantings which till then were their main source of income. Risda is thus able to consolidate some of the uneconomic rubber holdings into viable farm units by inducing the smallholders to give up their own holdings in exchange for bigger shareholding on Risda plantations.

Risda also has the responsibility to implement all research innovations speedily to the smallholder sector at the national level.

Public Sector Estates: Public Sector Estates of the State Governments are an extension of large-scale commercial plantations or estates run by private agencies. While they do not provide land for the landless, they nevertheless provide employment for the rural community. They allow for greater mobility of labour as the workers can seek more remunerative jobs as and when the opportunity arises. There is also no problem of loan repayment by the workers. For the State Government, it provides additional revenue in terms of profit.

State Land Schemes: Besides the Federal Land Development Agencies, each State also has its own agency to undertake land development and settlement for their landless, the youth and for revenue purposes. One of the State Governments has even set-up a Youth Land Settlement scheme purely for single girls.

Comparison of the different land schemes: Although several agencies in Malaysia are engaged in land development, the different schemes serve different functions. Felda's programme provides

employment and ownership of land for the landless rural people or those with holdings of less than two acres. Felcra's youth schemes meet the acute problem of unemployment among the youth and channel their energies into productive economic activities. Fringe schemes provide supplementary land holdings to farmers with uneconomic farm holdings while the rehabilitation schemes try to salvage those earlier schemes which have failed. Risda's block new planting generates additional income and ownership for rubber smallholders with holdings of five acres or less, while the public sector estates of the State Governments provide employment for the unemployed.

Lim Sow Ching, in his economic analysis of land development schemes in Peninsular Malaysia, has concluded that the Felda, State and Fringe Alienation Schemes are all economically viable and are highly justifiable in terms of social profitability. The schemes have succeeded in raising the standard of living of the settler-families and, except for the Fringe type, have enabled the settlers to achieve a reasonable level of income.

IMPACT OF SCIENCE AND TECHNOLOGY

The problems of the small farmers receive the special attention of R&D Institutes in Malaysia. In the case of rubber, the Rubber Research Institute of Malaysia has two Divisions, namely the Smallholders Project Research Division and the Training Division, whose functions are to adapt and transfer modern agronomic and processing practices as well as to provide training to rubber smallholders speedily. These research innovations are channelled through Risda which can utilise the latest research innovations and technologies in its replanting schemes. The Malaysian Rubber Development Corporation (Mardec), which is responsible for establishing central factories to process and market smallholder rubber into premium grades guaranteed under the "Standard Malaysian Rubber" Scheme has already built 16 factories in different parts of the country. Mardec has also entered into joint ventures for the manufacture of rubber products locally. These agencies (Risda and Mardec) provide the framework to ensure that R&D benefits the individual small farmer in the rural sector.

Use of the existing technologies on an area development approach can bring substantial additional benefits to the small farmer in the rural development programme. For rubber smallholders, increased benefits can be assured through stimulation of existing stands of low yielding rubber, replanting of these trees with high yielding clones, using advance planting materials to reduce the immaturity period, higher density of planting to increase yields per unit area, inter-cropping and mixed farming to provide alternative income especially during the immaturity period, discriminatory application of fertilisers, suitable methods of tapping and stimulation, and proper processing and marketing facilities. For most of these to be successfully implemented, an adequate credit facility on easy terms for the small farmers is vital.

Increasing emphasis is now being given in Malaysia to ensure that rural development programmes will benefit from the many scientific and technological advances that have been made.

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EVOLUTION OF A PROGRAMME ON RURAL DEVELOPMENT PLANNING AT THE ASIAN INSTITUTE OF TECHNOLOGY

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INTRODUCTION

The future course for the developing nations of Asia must emphasize the implementation of a large number of effective policies, plans, programmes, and projects. For such implementation to be effective, it requires a balanced understanding and a systematic guidance of the whole process of development. Experience with development in the past two decades has shown us that neither a complete centralization of development planning, nor a specific sectoral emphasis on economic planning, can achieve the goal of effective implementation.

The human settlements approach to development abandons both extreme centralization, and over-emphasis on economics, and focusses instead on the spatial units of society — its regions, cities, villages, and communities — as the appropriate units for the implementation of development. This approach requires a large number of policies, plans, programmes, and projects at different levels of spatial organization, and is therefore linked to a decentralized form of administrative and social organization.

By focussing on human settlements, we simplify the problem of implementation, while at the same time effectively linking together the knowledge accumulated in the various disciplines and professions engaged in the development process. We thus develop an integrated approach, an approach which gradually leads to a better understanding of the whole. A commitment to such an approach can overcome the neglect associated with centralized approaches or sectoral approaches, through an emphasis on the

entire ecological system — both natural and human — in which human settlements flourish. Ultimately, such a commitment aims at reaching all the people, particularly those that are now being neglected, and bringing them into the orbit of improvement and advancement.

The implementation of a human settlements approach to development is slowly taking place in many countries. To accelerate this process, several tasks can be delineated. First, it requires a large cadre of specially educated manpower in human settlements planning, development, management, and education. These professionals must be trained and committed to an integrated approach to development, familiar with all its aspects, and capable of putting together integrated and well thought out policies, plans, programmes, and projects.

The knowledge and the scientific information required for this task is sketchy and disorganized. It is partly transplanted from developed countries, and partly based on one-sided sectoral approaches. Reliable and relevant knowledge must be developed through original research and experimentation in the field of human settlements development in Asia. Many problems in Asia are unique and require special study. Thus, a considerable research effort in integrated development, which will be implementation-oriented, aiming at evaluating the efficacy of various policies, plans, programmes, and projects, is the second task to be accomplished.

However, professional manpower and good action-oriented research will not be enough. A human settlements approach to development requires considerable changes in development policy. Such a change requires modification of attitudes and perceptions of a very large number of people. This modification cannot take place without communicating with many groups in society on human settlements problems, issues and approaches. This is the third task: disseminating information to a large number of target groups in the region. Changes in attitudes and perceptions cannot take place by publishing scientific papers alone. Specific target groups must be addressed with specially-designed communication

packages, using a large variety of ways of transmitting information.

We conclude, therefore, that the effective implementation of a human settlements approach to development in the Asian Region requires, from an academic organization, action on three important tasks:

Educating high quality manpower for human settlements planning, development, management and education,
Research in human settlements in the Asian Region,
Dissemination of information on human settlements.

THE HUMAN SETTLEMENTS PLANNING AND DEVELOPMENT PROGRAMME AT AIT

An attempt to especially fulfill the task of educating high quality manpower for the planning of human settlements was made with the creation of the Human Settlements Planning and Development Programme at AIT in 1973. This programme provides graduate (post-Bachelor's degree) training to students from the countries of Asia. The duration of the training is normally 18 months: ten months for course work and eight for thesis research. The important characteristics of the Human Settlements Planning and Development Programme are as follows:

(1) Teaching and research is specifically tailored to the needs of less developed nations, with particular emphasis on the Asian Countries from which its students originate.

(2) The programme is problem-oriented with a focus on realistic plans and policies.

(3) Problems addressed by the students in their thesis research have been aimed at redressing inequalities in the distribution of development resources (Appendix 1).

(4) Research has been comparative in nature covering a number of countries in the region.

It will be obvious that this orientation has consequences for the way in which courses are taught and research is undertaken.

In teaching, theory is only referred to in so far as it is needed for finding solutions for practical problems: mathematics applied to quantitative models used in development planning; social change in order to explain the link with development of human settlements and introduction of technical innovations; planning theory limited to the use in planning and development of human settlements in the Asian Region; research methods and techniques for planning applications; and economic theory for project evaluation.

Research topics are often selected on the basis of priorities as perceived by policy makers, governmental organizations or the general public. In general the focus has been on low-income communities as target groups.

THE ATTEMPT TO CREATE AN INTEGRATED APPROACH TOWARDS DEVELOPMENT

The search for an integrated approach in development efforts is not new. In the planning profession we talk already for more than a decade about the need for "Comprehensive Planning", "Grass-Roots Planning" and planning "From the bottom upwards". We have to admit that it is relatively easy to talk or write about possibilities for an integrated development process but that it is on the other hand extremely difficult to implement policies, plans, programmes and projects in which multi-sectorial principles are basic guide-lines. Some of the reasons for this are:

(1) The degree of complexity of the socio-economic and political context, in which policies, plans, programmes and projects have to be implemented, is often underestimated.

(2) The fact that in society, variables operating in different sectors, at micro, meso and macro levels are often interrelated in such a way that integrated development efforts at micro levels become easily paralyzed or hindered.

(3) In the training of manpower, needed for initiation and guidance of development processes, emphasis has been on a sectorial approach. This approach leads to inter-

disciplinary planning teams which did not prove to be a guarantee for a balanced approach to development.

In the Human Settlements Planning and Development Programme we are experimenting with a multi-disciplinary approach in the training of manpower.

The framework which serves as a guiding principle is presented in Appendix 2.

Both students and faculty have a background in different disciplines: e.g., architecture, physical planning, civil engineering, electrical engineering, social-political science, geography.

During the graduate programme in which the student, on the average, has to take 10–12 different courses, he is exposed to different disciplines and gradually starts to speak the different scientific languages. A civil engineer develops skills to conduct a social survey, the social scientist is able to frame a simple physical design for a residential area.

In addition the student is free to select an emphasis in his training either within the programme, (e.g., social development) or outside the programme in other divisions of AIT (e.g., Water Resources Engineering). In research, value is also attached to projects involving multi-disciplinary skills. Examples are: socio-economic impact studies of various technical innovations; research on the low-income housing delivery systems in the Asian region, etc. In short, the Human Settlements Programme aims at training specialists within a general, accepted conceptual framework based on the various related disciplines. It will be obvious that the development of a programme of this nature takes time and needs constant evaluation.

RURAL DEVELOPMENT PLANNING AS A FIELD OF STUDY

In the past few years, too much emphasis has been placed in teaching and research on policies, plans, programmes and projects directed towards improvement of the quality of life in urban

settlements. Perhaps this was a consequence of the fact that in various planning activities aiming at regional and national development, urbanization linked with industrialization was given priority over the development of rural settlements. Gradually however we have become aware that problems in rural areas are often not only more acute but also that we have to improve living conditions in the rural settlements considerably in order to maintain the quality of life in the urban settlements at the same level.

This can be illustrated by the fact that over-urbanization in the Asian region is, in the first place, the result of rural-urban migration. Research on migration in the Asian region indicated that the main reasons for migration to the city are unfavourable socio-economic conditions in the rural areas.

So far, the priority given to development efforts aiming at urban development has been reflected in the Human Settlements Programme. Rural Development was only covered partly in teaching and research in the field of regional development planning.

In the past two years there was however a significant change in the focus of the research programme towards development problems in Rural Settlements. This change was partly the result of a growing awareness among engineers of the complexity of the rural socio-economic context in which they have to introduce their technical innovations and/or changes. At the same time national governments as well as regional organizations like ESCAP started to promote a change in emphasis in development efforts in favour of the rural settlements.

It is not surprising that AIT, being a regional organization aiming at a contribution in improving the quality of life in the Asian Region by a combination of manpower training and problem-oriented research, decided to initiate rural development planning as a separate field of study, in September 1977. Also in this field of study one of the basic principles will be to train specialists within a general conceptual framework: e.g., an agricultural engineer who has basic skills in rural economics, regional planning, social surveys, etc.

In research, focus will be on projects which have both societal and technical aspects. Examples are: impact studies of technical innovations and socio-economic evaluation of rural programmes and projects.

We realize that it will take a long time to develop a balanced curriculum and a long-term research programme in the field of rural development planning. We are however of the opinion that with the support from the existing fields of study at AIT this can be done. Students who will graduate in this field will have skills to deal with the large variety of aspects of an integrated approach to rural development.

APPENDIX 1
Thesis Research Projects 1975–76

Completed Research 1975–76

RURAL DEVELOPMENT

"Socio-Economic Factors of Resettlement in Response to Water Resource Development: Case Study in Lam Dom Noi (Thailand)".

"Some Institutional Factors in Agricultural Development: A Case Study in Rural Taiwan".

"An Analysis and Evaluation of Tambon Council Operations in Rural Development".

"The Position of Women and Their Contribution to Rural Productive Efforts: A Comparison Based on a Case Study of Chiang Mai, Thailand".

"The Position of Women and Their Contribution to Rural Productive Efforts: A Comparison Based on a Case Study of Kedah, Malaysia".

"The Role of Women in Rural Socio-Economic Development in Amphoe San Kamphaeng, Thailand".

"The Role of Women in Rural Socio-Economic Development in Northern Samar, Philippines".

"An Evaluation of the Forest Village System in Thailand".

REGIONAL DEVELOPMENT

"An Investigation of Relationships Between Various Concepts of Regional Spatial Development".

"The Impact of a Growth Center on Rural Areas: A Case Study of Northern Thailand".

"Analysis of Growth of a Region: Mindanao, Philippines".

"The Impact of a Growth Center on Rural Areas: A Comparison based on a Case Study of the Kandy Region, Sri Lanka".

"The Impact of a Growth Center on Rural Areas: A Comparison Based on a Case Study of Surabaya Region, Indonesia".

LOW-INCOME HOUSING

"Mini Squatters in Bangkok: Structure & Function".

"The Magnitude of the Squatter Population in Bangkok – 1974".

"People's Housing Resources: Preconditions for the Stimulation of Domestic Resources in Popular Housing in Bangkok".

"A Cost Indicator for Low-Income Shelter".

"Highrise Building for Low-Income People: A Comparative Cost-Benefit Study of the Huay-Kwang Project".

"Workers Housing on Industrial Sites: A Case Study of Bangkok, Thailand".

"Housing Building Techniques and Procedures in the Squatter Areas of Bangkok".

"A Feasibility Study of a Home-Ownership Program for the Public Housing of Hong Kong".

"A Southeast Asian Comparative Study of Low-Income Housing Delivery Systems: The Case of Manila".

"A Southeast Asian Comparative Study of Low-Income Housing Delivery Systems: The Case of Bombay".

"A Southeast Asian Comparative Study of Low-Income Housing Delivery Systems: The Case of Colombo".

"A Southeast Asian Comparative Study of Low-Income Housing Delivery Systems: The Case of Taipei".

"A Southeast Asian Comparative Study of Low-Income Housing Delivery Systems: The Case of Djakarta".

"A Southeast Asian Comparative Study of Low-Income Housing Delivery Systems: The Case of Dacca".

"Social Implications of Public Housing Policies: The Lesson of Hong Kong".

URBAN SOCIAL SERVICES DELIVERY

"Analysis and Evaluation of Family Planning Activities of a Health Center in Bangkok".

"The Trade Union as a Tool for Community Development".

"Community Development in Hong Kong Housing Estates: A Program Evaluation of the Work of Voluntary Organizations".

"An Evaluation of Government Public Services in Hong Kong: A Case Study of Education & Public Health".

"An Evaluation of Government Public Services in Hong Kong: A Study of Police Services".

"An Evaluation of Government Public Services in Hong Kong: A Study of Correctional Programs".

URBAN DEVELOPMENT

"A Study of Land Value Assessment for Bangkok".

"Industrial Location, Regional Development and Regional Disparity in Taiwan, 1969–1985: A Simulation Analysis".

"Share Economics: A Study of a Communal Saving System, in a Bangkok Slum".

"The Relocation Pattern of the Low-Income Population due to Public Housing — A Case Study in Bangkok".

"Towards Understanding the Dynamic Subsystem of Temporary Tenure Communities in Bangkok with Possible Alternatives for Community Improvement".

MIGRATION

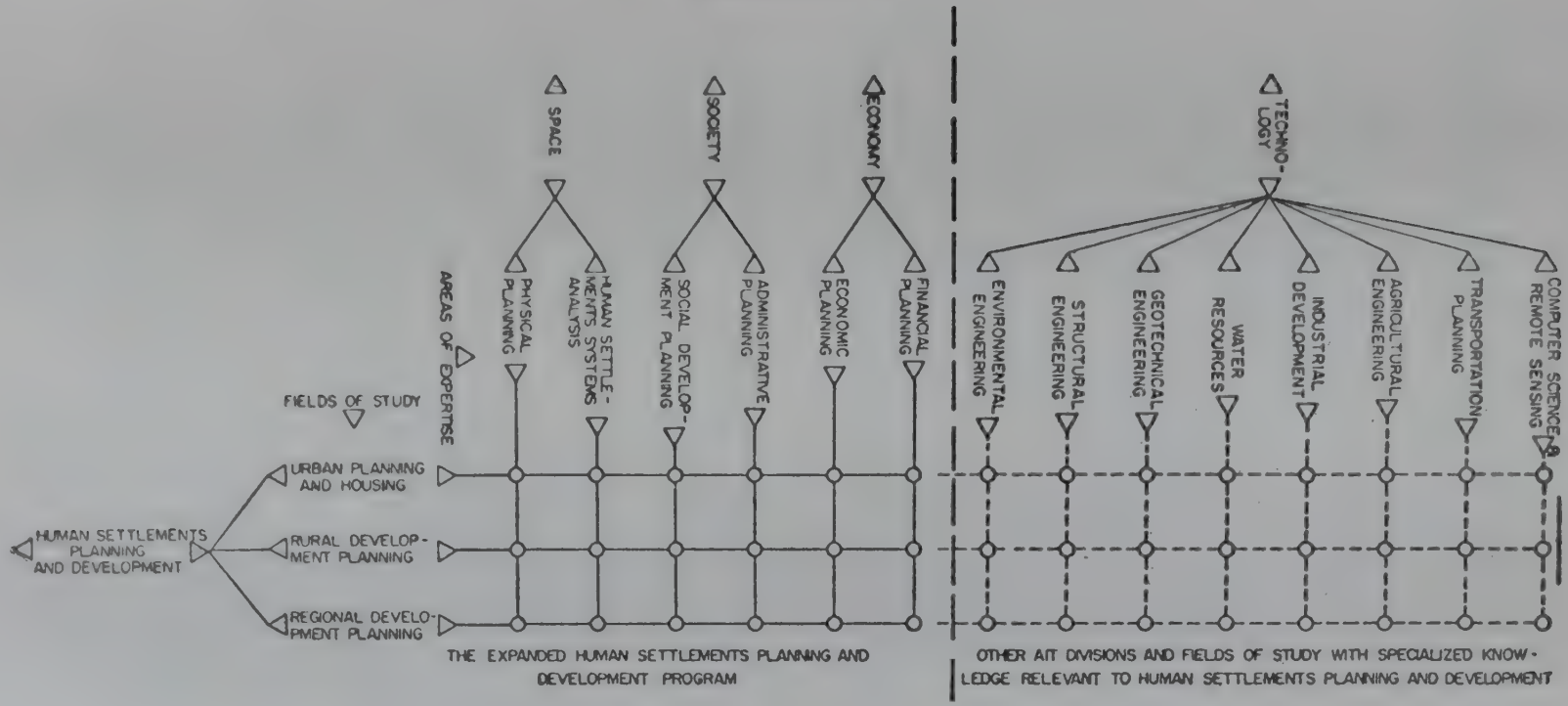
"The Urban Drop-Outs".

"The Desire to Migrate: A Case Study of the Image of the Primate City Among Rural Youths in Thailand".

NATIONAL DEVELOPMENT

"An Operational Goal System Evaluation for Project Selection".

APPENDIX 2



Proposed framework for academic development of the Human Settlement Planning and Development Program at AIT

RURAL AGRICULTURE AND ECONOMIC DEVELOPMENT

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It is indeed a pleasure to participate in this seminar on "Science and Technology for Integrated Rural Development" and I wish to thank COSTED for enabling me to do so.

Agriculture is an important activity in rural society and I take it that rural agriculture refers to the farming practised by small farmers as opposed to plantation agriculture on large estates, and that economic development implies not only an increase in GNP but also the satisfaction of social aspirations. Economic development and social justice must go hand in hand.

PRIORITY FOR AGRICULTURE-THEN AND NOW

It is indeed a welcome sign of the times that everyone is jumping on the agricultural bandwagon now. But this was not always so. As a member of the academic staff of a University Faculty of Agriculture since the early 1950s, I am only too painfully aware of the extremely low priority attached to agriculture in those days. In the early years of the Faculty of Agriculture in Sri Lanka we did not have more than a mere handful of 4 or 5 students. Lack of students made it impossible to get funds for building up the Faculty. This in turn made it difficult to provide facilities, equipment and staff to improve the teaching and to undertake research. The absence of facilities made it difficult to attract the better students. And so the vicious circle continued. I myself worked alone in the Division of Agricultural Chemistry teaching a number of different courses, from 1951 until 1967 when an Assistant Lecturer was appointed to help me. Agriculture was looked down on as a subject fit for less intelligent students who were not smart enough to study medicine, engineering, science

or even arts. The Faculty of Agriculture was treated like a Cinderella Faculty. Here in India, Agriculture was given a low priority in the first three economic plans. It is only in the Fourth and Fifth 5-year plans that agriculture has received due attention.

AGRICULTURE IN THE NATIONAL ECONOMY

But the importance of agriculture in the national economy should have been evident even to the most casual observer of the situation in developing countries.

The agriculture sector makes the largest contribution to the GDP, has the highest employment potential, and a major portion of the labour force is involved in agriculture. But even now the emphasis in the agricultural sector is on perennial plantation crops — at least this is so both in Sri Lanka and in Malaysia. It is part of the colonial heritage. In Sri Lanka the major crops are still tea, rubber and coconut; in Malaysia — rubber, oil palm and coconut. In colonial times, the rural folk were mere labourers on the plantations sweating away to produce wealth which went to enrich a minority and to give them a life style all their own. Estate labourers continued to live their miserable lives with little hope of breaking out of the vicious circle of inadequate work, a paltry wage, low standards of living, and starvation. Production of food crops was neglected. This is to a large extent so even now. And yet, because of population growth and increasing per capita incomes the demand for food becomes more urgent.

However, more and more persons are becoming alive to the need for improving rural agriculture and that is why we have seminars such as this organised by COSTED. These seminars are most useful especially as they bring scientists concerned about agriculture back to the reality in which they should be living.

NATIONAL POLICY AND RURAL AGRICULTURE

Two of the foremost problems in the developing world, unemployment and lack of self-sufficiency in food supplies, cannot be solved without a major transformation of the peasant, or rural,

agriculture sector. This transformation in turn can only be effectively carried out by four important commitments in national policy.

(1) The mobilization and participation of the people for changes in the agrarian sector through political leadership at the highest levels. A good example of this was the impetus given to food production in Sri Lanka during the period 1965–1970, when the rice harvest increased by a third in two years and the goal of self-sufficiency in rice was within reach.

(2) A much larger share of national budgets and agricultural price policies must be aimed at strengthening the rural agricultural base. Gone are the days when industry was thought to be the panacea for poverty in developing countries. During the 1950s, national policies and budgets as well as much international technical and capital assistance were geared towards industrial development.

(3) There must be a just, equitable and rational land reform which will increase agricultural production and enable those who actually farm the land to benefit thereby. Distribution of the gains from the new technologies must be made more even.

(4) Agricultural systems must be so designed as to make maximum use of the material and human resources locally available. Systems successfully employed in a different cultural and social environment are not likely to be appropriate and therefore will not take root in the agrarian setting of developing countries.

PROBLEMS OF IMPROVING RURAL AGRICULTURE

Improving rural agriculture in developing countries involves giving simultaneous attention to a number of problems: socio-economic, institutional, cultural, political and technological. Science and Technology can help in surmounting technological

problems but they are not sufficient by themselves to make rural agriculture move forward unless the other aspects are also tackled at the same time.

LAND REFORM, RURAL CREDIT, CROP INSURANCE

Land reform is an urgent need in countries where outdated land ownership and tenurial practices are major constraints in developing rural agriculture. Without a long-term interest in the land he cultivates and the availability of credit on reasonable terms, the rural farmer lacks the initiative to innovate and improve. In a rational programme of land reform, due consideration should be given to economic units of land, neither too small and fragmented as to prevent an adequate income nor too large that they cannot be easily managed. Agriculture is a hazardous venture, subject to the vagaries of the weather, to insect and pest attacks. Crop insurance schemes are needed to protect the farmer from losing everything during such natural calamities and in getting into debt as a result.

APPROPRIATE TECHNOLOGY

Raising acre-yields in intensive farming needs scientific knowledge and the appropriate technology. Improved seed, proper manure and fertilizers in the right amounts, agro-chemicals to protect crops from pests and diseases, energy for farm operations, and a controlled supply of water are needed in case the growing crop suffers from moisture stress. The research needed for crop production in developing countries should not be a crude and ineffective parody of that conducted in industrialized regions. It must be appropriate to the environment.

The miracle seeds of dwarf wheat, hybrid corn and lowland rice were hailed as the harbingers of a revolution in tropical agriculture. But alas the enthusiasm has been short-lived. The short, stiff-strawed varieties of rice from the International Rice Research Institute in the Philippines were fertilizer-responsive and yielded well only when enough fertilizer and water were available. They required about three times as much fertilizer as indi-

genous, tall and low-to moderate-yielding cultivars. In the wake of the fuel and fertilizer crises of late 1973, farmers were in a quandary. They could not afford to buy fertilizer whose prices had suddenly increased three to four times, even if they were available in the market. Rice yields fell dramatically. Since then rice breeders in developing countries have been looking for varieties that give a moderately high yield at medium levels of fertilizer application.

Another rather disturbing factor is the undue dependence on imported inputs such as agrochemicals and fossil fuel-powered machinery. Small farmers in rural areas cannot afford these, and even if they are provided on foreign technical assistance, they cannot be maintained over a period with the indigenous resources available. Local substitutes are often ignored. Composts, green manures and animal dung are seldom used. Ecological considerations favour the use of energy sources other than conventional fossil fuels. Agricultural wastes are themselves a source of energy that can be developed. All these can contribute to improved agricultural productivity in rural areas and ensure the maintenance of soil fertility as well.

NECESSARY INFRASTRUCTURE

In the case of annual food crops the technological inputs must be available at the right time and this usually involves a carefully co-ordinated operation. In Sri Lanka, for example, no less than ten different government departments and corporations were involved in the 1960s in getting the farmer to grow a healthy crop and secure good yields of rice. The land was provided by the Department of Lands and water by the Department of Irrigation. The Department of Agrarian Services was responsible for seeds and agro-chemicals. Agricultural instructors and extension officers from the Department of Agriculture gave technical advice. The farmer bought his fertilizer from the Fertilizer Corporation. At harvest, the Paddy Marketing Board entered the picture, while officers from the Co-operative Department and the Department of Food were also involved. The Department of Rural Development showed an interest and the *grama sevakas* from the Ministry of Home Affairs would also be concerned.

Unless all these agencies moved in at the appropriate moment at precisely the right time with the service intended for the farmer, problems arose. For their proper functioning the right infrastructure was needed. All too often politicians forget that agriculture should be a sustained operation performed season after season by farmers in the field and that the right infrastructure and the necessary inputs should be provided when needed and maintained.

SOCIAL ATTITUDES

There are also problems of attitude and of motivation which have a cultural background. In rural societies of the developing world the prevailing philosophies are not commercially oriented. Farmers are satisfied if they can meet their basic needs with a minimum of effort. They are more inclined to leisure, they would rather not work on public holidays even if this means postponing an essential field operation which needs to be timed according to the weather. In similar situations farmers in developed societies would give priority to farming needs.

POLITICAL LEADERSHIP

Finally, there is a need for dedicated leadership. It is all too easy to lose the initiative gained in pursuit of a multiplicity of other and less urgent national objectives. Improving the quality of life in rural areas through raising agricultural productivity is not an impossible task if the political will can provide the necessary leadership and the infrastructure within which the farmers themselves will surely grow the food needed.

THE USE OF SCIENCE AND TECHNOLOGY FOR RICE PRODUCTION IN SRI LANKA IN THE CONTEXT OF INTEGRATED RURAL DEVELOPMENT

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Let me thank the organizers of this seminar, for inviting me to read a paper on the use of science and technology for rice production in Sri Lanka in the context of integrated rural development. It is pleasing to note that the Committee on Science and Technology in the Developing Countries (COSTED) is actively concerned with the problems of integrated rural development in the developing countries and is engaged in seeking solutions for these questions by the use of science and technology. The people of the developing countries have a long way to go in reaching a decent standard of living, free from the ills of poverty and malnutrition, and it is opportune that seminars of this nature are held to focus the attention of all concerned on these problems. An era of rising expectations has dawned and with the improvements in knowledge and communications there is now a growing awareness in the minds of the people of the wide gap between cherished aims and achievements and between hope and fulfilment. Urgent action has, therefore, to be taken to bridge this gap so that humanity could progress and prosper in an atmosphere of peace, understanding and mutual help.

Rice is the staple food of the Sri Lankans. It is also the staple food for the peoples of South, South-East and East Asia. Over 90 per cent of the world's paddy, which is rice in the husk, is grown in these regions of Asia. The conversion of paddy to milled rice varies from about 62 per cent to 72 per cent. Despite

much effort by successive governments, Sri Lanka is still not self-sufficient in rice and is reported to have imported 375,000 tons in 1976. According to the Central Bank of Ceylon, after steady growth of production upto the year 1970 when paddy output more than doubled in this five year period, reaching 77.4 million bushels per annum, output thereafter has been erratic and increases have not been sustained. After a fall in the output in 1971, 1972 and 1973 there was a big crop in 1974 of 76.8 million bushels, which was followed by a very poor harvest of 55.3 million bushels in 1975. This low level of production has severely affected the growth rate of 1975 because paddy is a significant factor in the national economy. In 1976 the paddy crop suffered another set back and is said to be about the level of the 1975 output.

Details of the 1976 paddy production have not been published. However, in 1975 paddy production fell by 21.47 million bushels from 1974, a decline of 27.96 per cent. Drought is attributed as the main cause for the sharp decline in output and this is seen in the significant difference between the gross area sown and the gross area harvested, which was as much as 243,586 acres or 14 per-cent of the total area sown. Drought also shrank the physical extent sown from 2.04 million acres in the two seasons in 1973/74 to 1.7 million acres in the two seasons in 1974/75, a decline of 15.6 per cent.

There are two seasons in Sri Lanka for the cultivation of paddy, *viz.*, the *Maha* season or the *Kalapokkam* from October to March and the *Yala* season or *Sirupokkam* from May to August. In 1975 the fall in the *Maha* season was more pronounced than in the *Yala* season. The output in *Maha* 1974/75 was 34.46 million bushels as against 52.63 million bushels in the preceding *Maha*. This represents a shortfall in production of 34.53 per cent. Apart from a sharp decrease in the gross extent harvested, the average yield per acre harvested also declined from 47.72 bushels in *Maha* 1973/74 to 46.24 bushels in *Maha* 1974/75. The gross extent sown in *Yala* 1975 was 96,720 acres, which fell short of the extent sown in the previous season by 13.4 per cent, while the gross extent harvested declined by 80,636 acres or 11.8 per cent. The yield per acre harvested also declined in the *Yala* from 41.74 bushels in 1974 to 40.84 bushels in 1975.

With the substantial decline in the area cultivated, there was also a corresponding fall in credit disbursements and fertiliser issues for paddy in 1974/75. In 1974/75 only 43,111 tons of fertiliser were issued which was 37.3 per cent of the amount of 115,702 tons issued in 1973/74. Loans granted under the new agricultural credit scheme in 1974/75 totalled only Rs. 77 million as compared to Rs. 109 million in 1973/74.

It will be seen that there was a substantial reduction in activities in all sectors of rice production in 1974/75. Drought no doubt played a major role in bringing down production and it is clear that the availability of water is the most important factor in rice production. The ill effects of drought could have been reduced by the availability of irrigation facilities. The occurrence of drought and floods should have been foreseen by planners in an agricultural country and timely action taken by the construction of tanks and irrigation canals to meet such eventualities. The proper application of science and technology would have enabled the construction of irrigation facilities. Historical evidence of irrigation networks built by the ancient kings of Sri Lanka should have acted as an example and an encouragement.

Fortunately, in 1970, construction work on the Mahaweli Development Project was started, which besides generating hydro power and providing flood control, would create irrigation facilities for planned agriculture. The magnitude of the agricultural benefits of the Mahaweli Development Project can be clearly visualised by a simple comparison: the total extent of irrigated land in Sri Lanka is 925,000 acres, made up of 500,000 acres under major irrigation schemes while the balance of 425,000 acres is made up of land irrigated by medium and minor irrigation works. The Mahaweli Development Project, on the other hand, is capable of irrigating 900,000 acres under conditions now obtaining in major irrigation schemes. In view of the magnitude of the Mahaweli Development Project, the master plan drawn up for its implementation conceived construction in three separate phases. Each phase was further divided into separate projects to allow for separate project planning, financing and construction. Each project, though inter-connected, was planned as a separate viable

unit. The construction plan of the whole Mahaweli Development Project was phased over a 30 year period. The commissioning of Phase Project-1 of the scheme was done in January 1976 and this provided additional water for cultivation in Anuradhapura, Poloraruwa and Trincomalee districts. Such a project when completed, where science and technology play a significant role in increasing paddy production, will fulfil a long-felt need in the economy of Sri Lanka.

Science and technology could also be used in other directions to increase agricultural productivity. The productivity of agriculture has to improve to meet the food needs of poor countries. It is said that grain production in developed countries increased by 64 per cent between the early 1950s and late nineteen sixties on the basis of yield increases alone. There was no expansion of grain area. On the other hand, grain production in the developing countries increased by 78 per cent during the same period, but this was achieved through a 35 per cent expansion of grain area. The average yield increase was only 32 per cent which is half that of the developed countries. Again, in 1966–70 the grain yield in developing countries was only equivalent to the grain yield of the developed countries twenty years earlier. Technological innovation in agriculture is necessary to substantially increase the yields per acre. Several studies strongly support the view that the world's resources, if used effectively with improved technology, could produce sufficient food to substantially increase the per capita food production in the world.

At the U.N. World Food Conference held in Rome in November 1974, it was stated that modern technology has only begun to have an impact on agriculture in most developing countries. Although the developing countries have about 70 per cent of the world's arable land, they account for only 25 per cent of the agricultural machinery and fertiliser, and for only 15 per cent of the pesticides used.

New rice varieties were made possible by intensive research over many years. This was used by the developing countries only from the mid-sixties through the efforts of the International Rice

Research Institute in the Philippines. Now many international agricultural research centres for rice are working on problems in developing countries. Their efforts must be closely supplemented by indigenous research and seed varieties developed at international centres must be adapted to local conditions by research institutions located in the various countries, and in many cases, in a number of sub-regions of a particular country. In Sri Lanka, there are rice research stations, which are working in liaison with the International Rice Research Institute and with national rice research institutes of other countries. Zonal research stations to deal with the problems of that particular area have also been established. Research in Sri Lanka is carried out, *inter alia,* to improve, the new varieties of seed paddy, the type of fertilizer used and the resistance of plants to pests and diseases. Plants are generally limited to particular geographic regions, since certain varieties, which are very productive in one region are often far less so in other locations because of different soil and climatic conditions.

The average farmer should be provided with information on the improved technology best suited to his environment He is not well equipped, either in education or in financial resources, to keep in touch with the research institutes or the journals published by them. The agricultural extension officers, who act as the link between the laboratory and the field, should therefore see that not only do they transmit the latest information on improved technology but also act as advisers to the farmers. The information and advice given should be relevant and appropriate.

Constant research should go on, for improvements in technology bring about more productive combinations of inputs, better quality of rice and lower production costs. The whole exercise of improving rice production should be viewed in the overall context of integrated rural development. Such an approach will not only help in achieving the particular objective but also the development of the country in general. Most of the people of the developing countries living in rural areas are to a great extent dependent on agriculture for their livelihood. Hence, any approach to rural development has to deal mainly with agriculture. On the other hand, rural development means more than just agricul-

rural development. It could include such non-agricultural components as drinking water supplies, housing, rural electrification, roads, health facilities and education.

Integrated rural development would embrace all aspects of life in a rural community. The process of rural development must keep as its objective the integration of the rural people into the social, economic and political life of a country. Individual projects should be so designed that they should fit into a general plan committed to this overall objective. The rural people in the developing countries are generally poor and backward. It should, therefore, be the aim of rural development to remove their poverty and to raise their standards of living. Projects which would directly and in a very large measure help the rural poor must form a common element in all approaches to rural development.

The rural poor, in view of their circumstances, do not get adequate opportunities to use their talents in the development of their community. This group has to be more productive than in the past and rural development programmes must be formulated to increase their productivity and consequently their incomes.

Rural Development should also ensure that the poor enjoy the benefits of development, like improved educational and health facilities and nutrition.

Food problems cannot be solved in isolation from other problems of economic growth and development. In most developing countries it is necessary to generate productive employment opportunities. Many developing countries have high rates of rural to urban migration, but industrial job opportunities are growing slowly. Food can be produced with technologies making use of a variety of resources. Unless the techniques are such as to use the available resources for the developing countries, the problems of unemployment and related low incomes may generate great social tensions and seriously hinder overall development. Planning should, therefore, be done from below on the basis of detailed knowledge of local needs, resource endowments and potentialities. The focus must be on maximum utilisation of locally available

resources, particularly local manpower, rather than large-scale induction of inputs from outside.

A failure to achieve economic development will also seriously hinder the solution of the problem of population growth, which in turn will make economic development more difficult. This will be a vicious circle and both food production and economic development will be adversely affected unless a solution is found in the context of integrated rural development, where science and technology could play their appropriate role. This is the answer for Sri Lanka and the other developing countries if they want self-sufficiency in food production and adequate economic growth, factors which would assist in eradicating rural poverty and in raising the standard of living of all sections of their population.

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About COSTED.....

COSTED, Committee on Science and Technology in Developing Countries, has been constituted in 1966 and has been tackling problems of development in the broad sense of the word. Under the chairmanship of Prof. P.M.S. Blackett the Committee had undertaken a study of pressing problems of developing countries and had commissioned a book on "The Role of Science and Technology in Developing Countries". This was prepared by Dr. Graham Jones and has been received very well. The reconstituted COSTED, since 1972 under the chairmanship of Prof. S. Bhagavantam, has been trying to link education processes to the aspects of development. As a first step a series of seminars on "Resources and Environment : The Role of Science Education" have been organised. COSTED has organised special meetings in Accra-Ghana, Kuala Lumpur-Malaysia, Nairobi-Kenya, Colombo-Sri Lanka, Hyderabad-India, Bangalore–India and Buenos Aires–Argentina to deal with different aspects of development. Among other activities, COSTED has Rural Development Programmes in which priority is given to Rural Education on problems concerning basic health and agriculture. In these programmes, efforts are being made to generate local rural employment.

COSTED has nine individual members nominated by ICSU, 32 national members and 30 union members. Each national member and union member has a corresponding member on COSTED. Over 15 special reports dealing with subjects like Energy, Transportation, Technological Education, Technician Training and Information Services have been prepared. All these reports deal with special problems of developing countries. Recent publications of COSTED include, 'Science in the Service of Basic Human Needs' 'Science Policy for Development', 'Technical Information Services for Developing Countries', and 'Exploration Techniques for Groundwater'. All these publications can be obtained from the Scientific Secretary, COSTED, Indian Institute of Science, Bangalore-560 012, India.

Some other COSTED publications of interest: Available from the Scientific Secretary, COSTED.

1. *Science in the Service of Basic Human Needs,* October 1976 (Price* Rs. 25.00 or $ 5.00)

2. *Technical Information Services for Developing Countries,* April 1977 (Price*: Rs. 35.00 or $ 7.00)

3. *Exploration Techniques For Groundwater,* May 1977 (Price* Rs. 35.00 or $ 7.00)

* Postage extra.

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